Railway Mechanical Engineer

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Railway Mechanical Engineer

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Readers of the *Railway Mechanical Engineer* who have found matters of interest to them in the department entitled "What Our Readers Think" need not be disappointed when they fail to find it in the accustomed place immediately following the editorials because this does not mean that the department has been discontinued. For some time an increase in the interest our readers have taken in this department has been evident and the number of letters we have received for publication has been so great that at times we have been embarrassed to print them promptly in the subordinate position the department formerly occupied. Therefore, in order better to serve this interest, a "Readers' Page" has been established, following immediately at the close of the "Shop Practice" section. As the title indicates, this page—and more if necessary—belongs peculiarly to our readers. It is open to seekers for information on points of practice or other matters bearing on mechanical department affairs. It is open to those who will supply this information. It is also open to those who have opinions on any matters of interest to mechanical department officers and supervisors which they may not be prepared to present in the more formal manner implied by an article for one of the other departments, but of which they still wish to be unburdened. With a cordial invitation to use it, the editors place this department in the hands of the readers.

The readers' page

Railroad shops have, from time to time, been the object of criticism by some who would comment upon their relative "inefficiency" as compared with modern industrial plants. To endeavor to make a direct comparison between the two as a whole is to attempt something the ultimate success of which is doubtful. The industrial plant is, as a rule, engaged in a class of work which lends itself to the efforts of the production engineer. Production depends on the demand for the product and, once this demand is established, given the necessary supply of raw materials, the whole job can be planned with exactness and carried through to completion. In comparison, it is extremely difficult to forecast with any degree of certainty the demand for the "product" of the railroad shop. Even granting this possibility there is one disturbing element that the railroad shop has to contend with—the emergency job. There is one basis of comparison, however, between the railroad shop and the industrial plant which is not only worthy of serious thought but which railroad shop supervisors can ill afford to ignore. That is the element of unproductive man-hours. Time studies in industrial plants have done much to eliminate idle time, principally because the time-study records have played up the enormous losses and evidenced the necessity for careful planning. The locomotive shop scheduling system and the progressive car repair system are outstanding examples of efforts to eliminate idle time by careful planning. And it is not unreasonable to hope that, by a scientific study of methods and an intelligent classification of repair work, the "emergency job" may at least be isolated to such an extent that its effect on routine shop work will be negligible. Within the past two or three years many large repair shops have inaugurated production methods with such highly successful results that there can be no doubt as to the value of scientific planning and its adaptability to railroad shop work. It eliminates idle time, reduces the burden of supervision, anticipates delays and minimizes material shortages. These factors are all reflected in a lowered cost for maintenance of equipment.

Is your shop on a schedule?

Probably not a car foreman in the country, and certainly few railroad operating men, will dispute the statement that the proper inspection of cars requires expert judgment on the part of experienced car inspectors. Nevertheless, relatively few of these same car foremen are carrying on, to the extent desirable, educational work with their car inspectors or among the men from whom the future car inspectors will be selected. It is too generally assumed that a man with a few years experience on the "rip track," a limited knowledge of the interchange, safety appliance and loading rules and the ability to copy car numbers is fitted to become a car inspector.

The car inspector's judgment

Yet upon this man, picked without adequate consideration of the requirements of the position to which he is assigned, rests the authority to delay traffic by the mere act of applying a bad order card, or to pass upon an empty car intended for movement across the continent of a valuable and easily damaged commodity. This is the man who, in the exercise of his judgment, moves or delays the traffic of the country; for, as was pertinently said at the December meeting of the Chicago Car Foremen's Association, the car inspector's authority exceeds in certain respects that of the superintendent and other higher railroad officers. After the traffic department, for example, has solicited a shipment, the agent furnished a car, the yard forces placed it for loading and then put it into a train, and the transportation department rushed it over the road, up steps a car inspector at an intermediate point and applies a bad order card. The efforts of the other departments to expedite the movement have gone for naught. The result is a disgusted shipper and a disgruntled consignee, all because the car inspector has exercised his judgment. If his judgment is poor the shipment has been unnecessarily delayed; if it is good he has protected the movement of the shipment and other property.

There is no employee on American railroads to whom more attention should be paid, upon whom more edu-

cational effort should be extended, for whom more incentives should be provided, than the car inspector.

The mere act of examining a man superficially will not suffice. Definite standards must be set, means provided for attaining these standards and frequent practical tests conducted by someone thoroughly familiar with the requirements, to check up each step of the progress made.

Water rises no higher than its source; and an inspection organization can advance no farther than the knowledge, training and ability of the individual inspectors will permit. Improve the car inspector's judgment by careful training and frequent checks.

Control of workmanship in welding

Probably no process among the many metal working and forming processes employed in the railroad shop depends for the success of its application so completely on personal skill and fitness as does the autogenous welding process. Like all other processes, it is true that many of the requirements for satisfactory and reliable results are of a perfectly tangible nature, controlled by ordinary methods of supervision. Some of these factors are the selection of size and composition of welding wire, the selection of current value in the case of electric welding, or the character of the flame in the case of gas welding, the preparation of the surfaces of the pieces to be joined and proper design of the weld. But after a knowledge of these and other similar factors has been acquired and applied through systematic methods of supervision, there is still left one of the biggest factors in the success of the results—the personal skill and adaptability of the welder.

In most other shop processes, the quality of workmanship can usually be determined by surface inspection of the work after its completion or by other equally tangible means. In autogenous welding, however, even though much supervisory skill has been developed, the shortcomings of the workman are, to a relatively large extent, concealed. The problem of workmanship control is, therefore, to effect some means of determining in advance of performance what will be the quality of the workmanship. There is a growing appreciation of the importance of this difficult problem and its solution in being attacked vigorously in the industries, as well as on some railroads. Elsewhere in this issue will be found an article describing a system of operator control developed primarily for the industrial application of welding which, however, should be highly suggestive of what can be done along similar lines under railway shop conditions. Perhaps the two most important points in this article are the suggestions with respect to training operators—never taking for granted that because a man has proved reliable on one class of work he may be entrusted with another without undergoing special training to meet the changed conditions of the new job—and the other is the development of a systematic and periodical check of each operator's workmanship by means of sample welds, the quality of which may be determined by testing to destruction, either in the shop or the laboratory, or preferably both.

The autogenous welding processes have been the means of effecting remarkable savings in the costs of performing many jobs in the railroad shop. In the developing of the art the processes have been applied in some cases to jobs for which apparently they were not adapted, but if the application of the processes can be brought to a sufficiently high state of perfection, they might still be found to be thoroughly adapted to some of these jobs. Such a state of perfection, however, can only be obtained when all elements of the process are brought thoroughly under control and not the least important of these elements is the quality of workmanship. This can only be insured, first, by the temperamental fitness of the welder, second, by thorough training under each set of conditions before employment on important work, and third, by the frequent and systematic checking of the workman's skill and the quality of his performance by testing sample welds.

The younger men

Few developments in the railway field in recent years have made a greater appeal to the average railway officer or foreman than the movement to help the younger men "find themselves" and to develop along the right lines. This was started in a large way two years ago at St. Louis, under the direction of the Railroad Y. M. C. A., and in connection with its triennial convention. That organization had been giving more or less thought to the needs of boys and younger men in railroad service for a number of years, and several experiments had been tried out at different points on a smaller scale. The first national gathering of the younger men at St. Louis was comparatively small and in the nature of an experiment. It proved so fruitful, however, that a second meeting was held at Detroit a year later. It proved to be a great success, because of the long and painstaking efforts of the local organization of railroad men in developing the plans, and the co-operation of boys' work experts from both the local and the national organization of the Y. M. C. A. Inspired by this meeting, the Chesapeaks & Ohio held a system younger men's conference along similar lines. Naturally, on the basis of these three conferences, it was possible to improve greatly the technique of handling conferences of this kind, and the national conference held in Pittsburgh last November proved to be very much more effective than any of those which preceded it. Moreover, there is every reason to believe that the Pittsburgh conference will be followed up in the local fields and the inspiration which was started there conserved in a far greater degree than for the preceding national conferences.

One striking illustration of this was the second annual Christmas banquet of the apprentices on the Missouri-Kansas-Texas at Parsons, Kan. The young men reproduced the high spots of the Pittsburgh meeting in a sort of "mock conference." One of the principal features of the national conferences is the filling out of certain blanks by the young men. indicating what kind of work they would like to be engaged in ten years from now and why they think they are fitted for it. On the basis of these reports, small groups of the younger men are assigned for advice and counsel to practical railroad officers who are best fitted to help them. In addition to the reproduction of the high spots in the important addresses at the Pittsburgh conference, the "mock conference" at Parsons reproduced these vocational counseling groups with excellent results. It is significant, also, that at the Parsons meeting several of the general officers of the railroad, including Vice-President Whitenton and Mechanical Superintendent Warden, were present and made short addresses.

The delegates from other roads at a number of local points have carried much of the inspiration of the conference back to their fellows, and this is resulting in the formation of a number of American Railway Employed Boys' Clubs, or similar organizations. In general, these clubs aim to encourage the boys along educational, physical, social and spiritual lines and to make them better citizens. It is significant, also, that several of the railroad clubs, inspired by the Younger Railroad Men's Conferences, have inaugurated "Younger Men's Nights" and are doing much to stimulate a greater interest among railroad officers and foremen in encouraging the younger men and

helping them better to prepare themselves for their life work and to fit themselves for better positions. It is difficult to estimate the great value of this development which is steadily growing in size and force. Taken in connection with the increasing number of modern apprenticeship systems in the mechanical departments of the railways, it promises to do much to insure the right kind of men and leadership for the future.

Monorail vs. power truck

Monorail material handling systems, equipped with electric, pneumatic, or chain hoists are used extensively in railroad shops and enginehouses for the transportation of heavy parts from one department to another, or from one machine to another. They are great labor savers as are also the gas or electric power trucks with jib crane attachments which are becoming increasingly popular with railroad men because of their flexibility and the fact that they can get from one place to any other quickly and lift a load from almost any position. A recent editorial in a foreign railway paper commenting on these two forms of intershop communication somewhat to the disparagement of the electric truck with jib crane attachment, brought the following comment from an American general superintendent of motive power: "The truth of the matter is that the electric trucks are invaluable. Our first equipment of this sort is in operation at G——— and it is surprising what can be accomplished with it. I really don't think the average railroad outside of probably the X. Y. Z. (mentioning a railroad which has been a leader in the use of labor-saving shop equipment), appreciates the preference of these electric trucks to the monorail."

A careful analysis of the matter will undoubtedly show that the monorail system, with the particular type of hoist best adapted to individual needs, has its own special field of usefulness; the power truck, whether electrically or gasoline motor-operated, and whether used as truck or tractor, has another important field of usefulness; and for still other conditions, the power truck with jib crane attachment is by far the best adapted.

It is not difficult to get enthusiastic about the modern power truck as used in railroad shops and enginehouses. It is ruggedly built, powerful, economical in use and upkeep, and easy to operate. The particular electric truck referred to by the general superintendent of motive power was operated by an inexperienced man after 10 min. explanation of the functions of the various operating handles. At the end of the day, according to the testimony of the shop foreman, this man was apparently operating the truck as carefully and as well as the manufacturer's representative.

It may be said that the electric truck, while having ample power, is not a "mud horse," or a "mountain goat." Largely on account of the small diameter wheels, it requires hard, smooth passageways for efficient operation. With the crane attachment, it will handle a locomotive boiler front, smoke stack, bell, air compressor, feed water heater, main rod or piston with equal ease. The older railroad mechanic who remembers how he had to rig up a "sky hook," staging, or platform and chain falls, and then look up four or five helpers to assist in removing some of these parts from locomotives, finally hauling the parts laboriously on a two-wheel truck through the shop or enginehouse, is duly appreciative and thankful for the modern power-operated truck which saves so much of time and hard, dangerous manual labor. The master mechanic, shop superintendent and mechanical department head also are appreciative, for they can readily trace the influence of the power truck in reducing locomotive and car material handling costs and, moreover, materially speeding up the time when equipment can be returned to service.

Nineteen twenty-five

During the year 1925 the railroads handled a large, but not record-breaking, traffic; they placed orders for a comparatively small number of locomotives and freight cars and a few less passenger cars than were placed on the average during the previous three years; their purchase of machine tools and shop equipment varied but slightly from those made during the preceding year, and present indications are that they will continue on about the same basis during 1926. The operating statistics for the railroads of the United States indicate a splendid locomotive performance and a continuance of the satisfactory equipment conditions which obtained during 1924. In these two features of the year's operation, the mechanical departments of the railroads have reason to feel a large measure of satisfaction in that they have had no small part in the splendid record for effective service and efficient performance which characterized the 1925 railway operations.

During the year Railway Age statistics show that orders for 1,065 locomotives were placed for service in the United States and Canada, which compares with 1,484 in 1924; 2,026 in 1923, and 2,668 in 1922. The orders for freight cars for service in the United States and Canada numbered 93,458, which is the first year since 1921 in which the number of cars ordered has been less than 100,000. Orders for 2,241 passenger cars were placed for service in the United States and Canada, and while there has been a less marked recession here than in the case of either locomotives or freight cars, the orders still are the smallest which have been placed since 1921; the figures for the three preceding years are 2,469 in 1922; 2,477 in 1923, and 2,654 in 1924. An indication of the growing field for the rail motor car is found in the fact that 149 cars of this type, including trailers, were ordered in 1925, as compared with 120 in 1924, 76 in 1923, and 51 in 1922.

Elsewhere in this issue will be found a list of the machine tools and shop equipment purchased by the railroads during 1925, this being the second year that information on this subject has been available. The interesting fact in the machine tool and shop equipment market situation is the insignificant variation in the amount of equipment purchased last year, as compared with 1924, and the fact that the budget information available indicates that there will be little variation in the amount of equipment purchased during 1926. Comparing this with the orders for equipment, there is evidence of a degree of stability in the shop equipment market which is lacking in the other, although it is worthy of attention that the two years for which these data are available have not covered a sufficiently wide range of railroad business conditions to indicate clearly what effect, for instance, a large increase in traffic might have in increasing shop equipment expenditures.

During 1925 no marked change in the condition of equipment has taken place, although the tendency with respect to locomotives has been toward improvement. During the ten months of the year for which the data are available, the percentage of unserviceable to total locomotives in freight service was reduced from 18.8 for 1924 to 18 per cent for 1925. In the case of passenger locomotives, the same condition holds, with the reduction from 18.5 to 18 per cent. Freight car conditions have remained practically unchanged, the per cent unserviceable to total cars on line having averaged 7.8 per cent for the first 10

months of 1924 and 7.9 per cent for the same period of 1925.

What is of particular interest, however, is the increasing service which apparently has been obtained from the locomotives actually in use during 1925 and the efficiency with which this service has been rendered. The average freight train loads during the months of heaviest traffic in 1925 were materially larger than they have ever been before. The average freight train speed has also continued the tendency to increase which has been evident for the past two or three years. The combined result of these two factors was an increase of about 1,000 gross ton-miles per train-hour in the average freight train performance of the country during the months of heavy traffic in the fall of 1925, with something more than 20,000, as compared with similar months of 1924 with something more than 19,000. Average train loads since July have exceeded 1,700 tons, exceeding by 75 to 100 tons the average train loads during similar months of the previous year. No doubt, the larger train load is to a considerable extent a reflection of the increasing tractive force of locomotives in freight service. It is also, no doubt, partially the result of better train loading, although it is evident that this was not carried to a point of overloading because during the peak traffic of October, which shows the largest movement of gross-ton miles of any month recorded, the average freight train speed was 11.6 miles per hour, as compared with 11.4 miles per hour in October, 1924, during which month the total traffic movement was less. The miles per day per locomotive owned increased from 60.8 in October, 1924, to 65.5 in October, 1925, and the miles per day per locomotive reported in actual service increased from 84.4 miles per day in 1924 to 89.9 miles per day in 1925. In this performance an increase in locomotive utilization is indicated.

Attention should also be called to the fuel performance, in which officers and employees of the mechanical department have had no small part. For the first 10 months of 1925 the freight traffic of the United States was moved with an everage of 138 lb. of coal per 1,000 gross ton-miles. It took 148 lb. of coal to perform the same service during the same period of 1924. Similarly, in passenger service, the fuel consumption per passenger train car-mile was reduced from 16.8 lb. during the 10 months' period of 1924 to 16 lb. in 1925.

During the first 11 months of the year for which actual data are available, there was an actual decrease both in the number of locomotives and in the aggregate tractive force on the railroads in the United States, although in those regions where material traffic increases took place, the aggregate locomotive tractive force increased. For the country as a whole all the statistical data bearing on railroad performance affected by equipment utilization and equipment conditions all show that the situation has been eminently satisfactory, for which mechanical department officers and employees should receive the full measure of credit due them.

New Books

Training Key-Men in Industry. Report No. 75, Policyholders' Service Bureau, Group Insurance Division, Metropolitan Life Insurance Company, New York.

This pamphlet (8½ in. by 11 in., 20 pages), contains a number of important suggestions which will be of value to railroad supervisors who are interested in training for better leadership. In discussing the topic, "The Foreman Plays an Important Part," the report contains the following significant paragraph.

"In all probability few foremen appreciate what important factors they are in the lives of those whom they supervise. If the day begins with a snarl from the boss, if the atmosphere is tense, if inefficiency and chaos prevail, it inevitably follows that work is performed unwillingly and carelessly, for the pleasure of working with a team and working well has been destroyed. The men themselves may not know why life is dull or why they do not like to work in a certain shop or plant. The foreman, meanwhile, being unconscious of the nature and power of his influence, thinks his men uncommonly stupid and ill-dispositioned, while the production records tell the results of friction.

"Obviously, certain characteristics such as leadership, self-control, initiative and tact are needed for good foremanship. These qualities are born in men, but much can be accomplished through training to develop them, and thus the ability to bring forth men's best efforts."

The report discusses first the several requirements of a good training course, which are listed as follows: (1) The management must have a progressive attitude and a sincere desire to share its knowledge and responsibilities with the foremen; (2) the leader or the instructor of the classes must know his subject and be able to put it over with the men; (3) the group of foremen must be carefully selected; (4) the material presented in the course must meet a real vocational need. Each of these points is amplified and other requisites are also mentioned.

In discussing what to teach the foremen, special reference is made to a report of the Federal Board for Vocational Education in Bulletin 36, of the Trade and Industrial Series No. 7. This presents a complete course of foreman training, which can be adapted to specific industries or plants. Mention is also made of the course of study prepared by the Business Training Corporation, and outlines are given of the United Y. M. C. A. Schools course in foremanship, and also of a course prepared by the University of Wisconsin.

Three methods of training foremen are discussed, including the lecture method; the text study method, which is usually combined with lectures or informal conferences; and the group conference method, which is best adapted to groups of 12 or 15 men.

Other questions which are discussed in the report include the cost of foreman training, how to set up foreman training, a statement of accomplishments in a number of industrial plants, and a short bibliography, including a few books, several articles in publications and a number of conference reports. An appendix contains an outline of the foremanship training course of the Submarine Boat Corporation at the Newark Bay Shipyard.

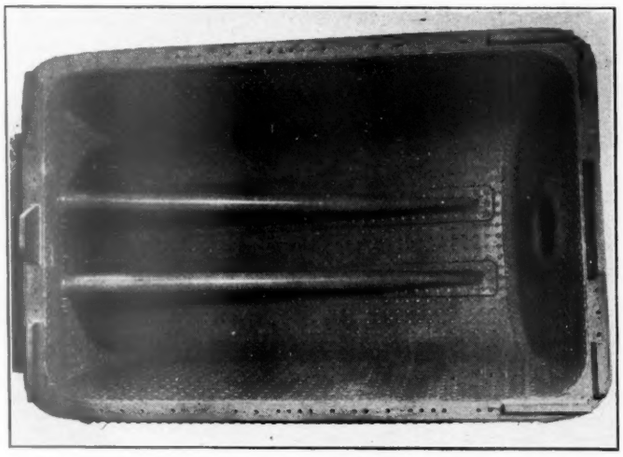
Master Blacksmiths' Proceedings. *Edited by William J. Mayer, secretary, Detroit, Mich. 127 pages, 5½ in. by 8 in. Bound in cloth. Illustrated.*

The report of the twenty-ninth annual convention of the International Railroad Master Blacksmiths' Association held at the Hotel Winton, Cleveland, Ohio, August 18, 19 and 20, 1925, contains many papers which are of interest and value to blacksmith foremen and others interested in the work of the blacksmith shop. Besides the regular business reports of the association, the book contains reports and papers on such subjects as autogenous welding, carbon and high speed steel, drop forging, frame making and repairing, heat treatment of iron and steel, reclamation and tools and formers. The various papers and reports have been carefully edited by the secretary, Mr. Mayer, and the arrangement of the contents is such that any information desired is easy to find.

Texas & Pacific 2-10-4 locomotives

Engines, known as Texas type, have four-wheel articulated trailer—Tractive force with booster, 96,000 lb.

THE Texas & Pacific has recently received 10 locomotives from the Lima Locomotive Works, Inc., which are the first to be built with a 2-10-4 wheel arrangement. These locomotives are known as the Texas type, and are similar in the principal characteristics of their design to the Lima A-1 first placed in service on the Boston & Albany early in 1925 and since tested on several other roads. Both designs include the articulated four-wheel trailing truck carrying a large firebox; both have articulated main rods, and the cylinders in both cases operate at a maximum cut-off of 60 per cent. The new locomotives, however, have one more pair of driving wheels, making a 2-10-4 wheel arrangement, which increases the length of the boiler and the tractive force.



The fire-box is equipped with Nicholson thermic syphons

They also differ from the Lima A-1 in that they are fitted for oil-burning service.

The new locomotives have a total engine weight of 448,000 lb., of which 300,000 lb. is on the driving wheels. With a boiler pressure of 250 lb. and 60 per cent cut-off, they develop a tractive force of 83,000 lb., which is increased to 96,000 lb. when the trailer booster is in operation. A comparison of these and other of the principal dimensions, with similar dimensions of the Lima A-1, is given in the table.

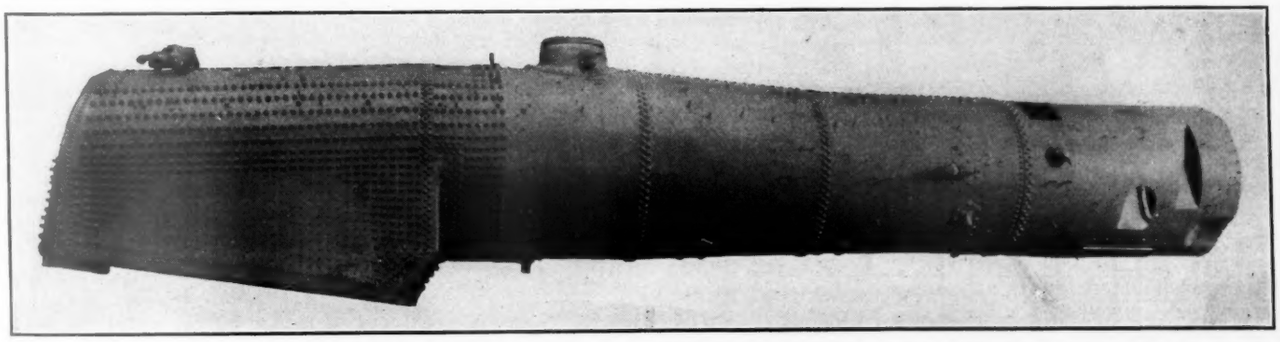
Referring to this comparison, it will be seen that the weight on drivers of the new type locomotive averages 60,000 lb. per pair, which is 2,000 lb. less than the average driving wheel loads of the Lima A-1. The weight on both the front and rear trucks, however, is greater than in the case of the former locomotive, the total difference in weight amounting to 63,000 lb.

A comparison of the boiler proportions of the two designs is also of interest. While in total evaporating heating surface and superheating surface the new locomotives differ but slightly from the A-1 locomotive, there is a material difference in the distribution of the evaporating heating surface as between the firebox and tubes. The tubes and flues in the new locomotives are 1 ft. 6 in. longer than those in the earlier locomotive, but are fewer in number, accounting for the reduction in the amount of tube and flue heating surface. The firebox, however, including the combustion chamber and the two Nicholson thermic syphons, has a materially larger amount of heating surface, the proportion of firebox heating surface to evaporative heating surface thus being increased from 6.6 per cent in the Lima A-1 to 9.26 per cent in the new locomotives, a difference which, on the basis of Cole's ratios, would account for approximately 10 per cent more evaporating capacity. The increase in cylinder tractive force from 69,400 lb. to 83,000 lb. amounts to about 19

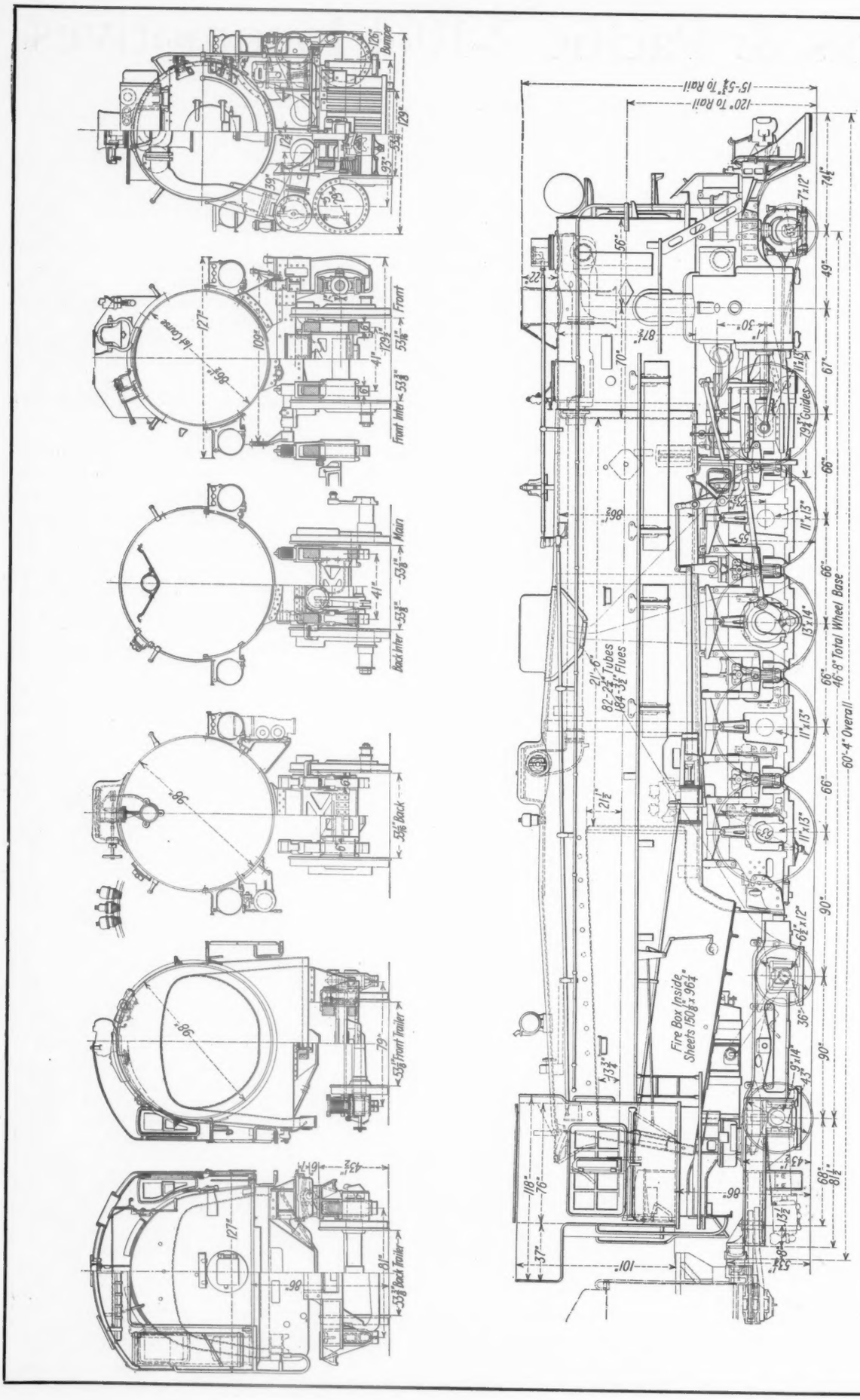
Comparison of Texas & Pacific 2-10-4 locomotives with Lima 2-8-4 locomotive

	2-10-4	2-8-4
Cylinders, diameter and stroke, in.	29 by 32	28 by 30
Cut-off in full gear, per cent	60	60
Boiler pressure	250 lb.	240 lb.
Weights in working order:		
On drivers	300,000 lb.	248,000 lb.
Front truck	41,800 lb.	35,500 lb.
Rear truck	106,200 lb.	101,300 lb.
Total engine	448,000 lb.	385,000 lb.
Diameter of drivers	63 in.	63 in.
Heating surfaces:		
Firebox and combustion chamber	473 sq. ft.	337 sq. ft.
Tubes and flues	4,640 sq. ft.	4,773 sq. ft.
Total evaporating	5,113 sq. ft.	5,110 sq. ft.
Superheating	2,100 sq. ft.	2,111 sq. ft.
Combined total	7,213 sq. ft.	7,221 sq. ft.
Grate area	100 sq. ft.*	100 sq. ft.
Rated tractive force:		
Engine	83,000 lb.	69,400 lb.
Engine and booster	96,000 lb.	82,600 lb.
Factor of adhesion	3.62	3.58

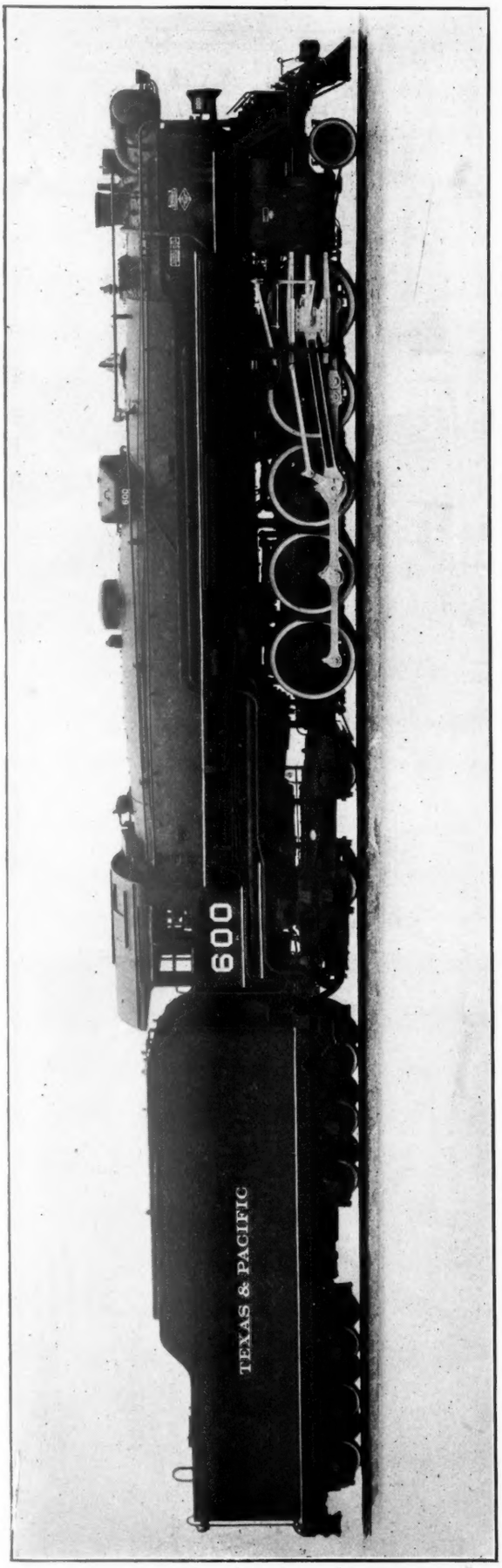
* The firebox is fitted for burning oil.



The boiler—The fire-box measures 150⅛ in. by 96¼ in. at the mud ring



Elevation and cross sections of Texas & Pacific 2-10-4 type locomotives



The total weight of this engine is 448,000 lb., the weight on drivers, 300,000 lb.—The articulated trailer carries 106,200 lb.

per cent. The Texas type locomotives will be assigned to the Ft. Worth and Rio Grande divisions between Marshall, Tex., and Big Springs, a distance of 450 miles. The ruling grades on these divisions approximate 1.5 per cent and extend from five to eleven miles in length. Heavy curvature is encountered, making necessary the use of the booster in ascending the heaviest portions of these grades.

The boilers of the new locomotives, aside from the increase in length made possible by the increase in the wheel base, differ principally from the boiler of the A-1 locomotive in the inclusion of a 42-in. combustion chamber, in the location of the dome just in front of the combustion chamber, and in the use of an inside dry pipe. It will be remembered that the dome in the earlier locomotive was located on the front boiler course, with a short outside dry pipe. The dome course in the new boilers is 98 in. in outside diameter, this being reduced by a taper course to 86½ in. at the front course. A shut-off valve, by which the entrance to the dry pipe may be closed, is located in the dome, the operating handle extending out through the right side of the dome. The tubes are 21 ft. 6 in. long and the tube sheets are laid out with 184 flues 3½ in. in diameter, for a Type E superheater of 92 units. With the exception of the change in the dry pipe, the front end arrangement is essentially the same as that of the Lima A-1. The unit bolts of the superheater header are accessible through a rectangular opening in the top of the smokebox shell and the Chambers front end throttle is located between the superheater header and the branch pipes forward of the smoke stack.

The firebox, which has the same inside dimensions at the mud ring as the Lima A-1, is fitted for oil-burning service, with a 4-in. Booth burner entering the front of the draft pan which is set back about one-third the length of the firebox from the front of the mud ring. The locomotive is designed, however, for possible later conversion to coal-burning service, in which case the two Nicholson thermic syphons will serve as arch supports.

The locomotives are fitted with an Elesco feedwater heater carried on brackets on the front end. The feedwater pump is located under the running board on the left side of the locomotive.

Cylinders, frames and running gear

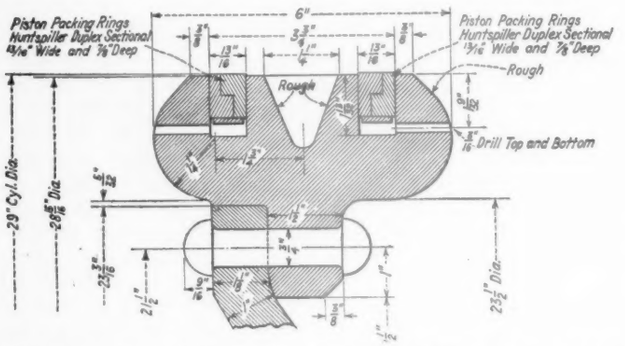
The cylinders are 29 in. in diameter by 32 in. stroke. They are steel castings with Hunt-Spiller gun iron bushings and, like the cylinders of the Lima A-1, the exhaust steam is carried from extension valve chamber heads through cast pipes which are bolted to openings on the front and back faces of the saddle casting, from whence the exhaust steam is carried inward and upward through cored passages to the exhaust nozzle base at the top of the saddle. These are the only steam passages in the saddle portion of the cylinder castings. The exhaust nozzles are fitted with tips having the Goodfellow internal projections.

This cylinder construction is shown clearly in one of the illustrations. It has made possible a reduction of the metal sections such that a saving of approximately 4,000 lb. has been made in the weight as compared with equivalent cast iron cylinders.

The valve chamber bushings are fitted with the usual auxiliary starting ports necessary where the locomotive is to operate at a limited maximum cut-off, and in order to effect the maximum attainable smoothness of starting torque the cut-off at the front end of the cylinder is increased to 63 per cent at starting and slow speeds by lengthening two of the ports in the front valve chamber bushings. Where the auxiliary starting ports were formerly placed at the bottom of the bushings, they have

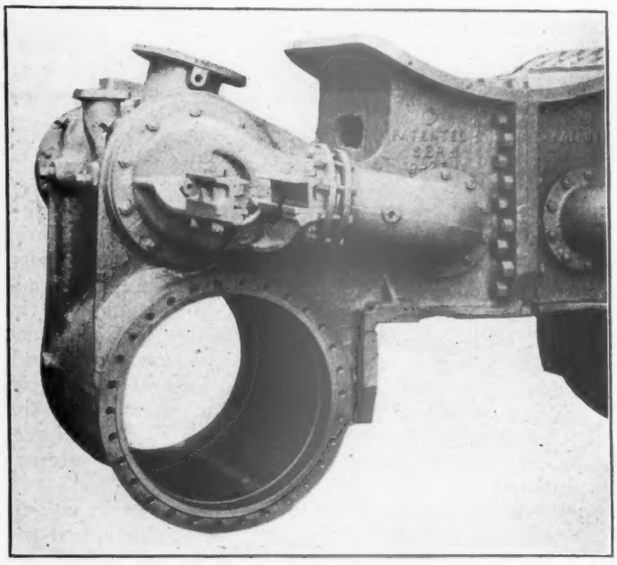
been moved around to the outside of the bushings in the Texas type locomotives, making them accessible for examination and cleaning by the removal of plugs from the outside walls of the valve chamber. Steam distribution is controlled by Baker valve motion producing a valve travel of 8¾ in., and by the Alco reverse gear.

The frame and running gear designs are the same in principal as those of the 2-8-4 type locomotive. The main frames terminate just back of the rear drivers and between them is bolted a heavy steel hinge casting in



Detail of the piston bull ring and Hunt-Spiller Duplex sectional packing rings

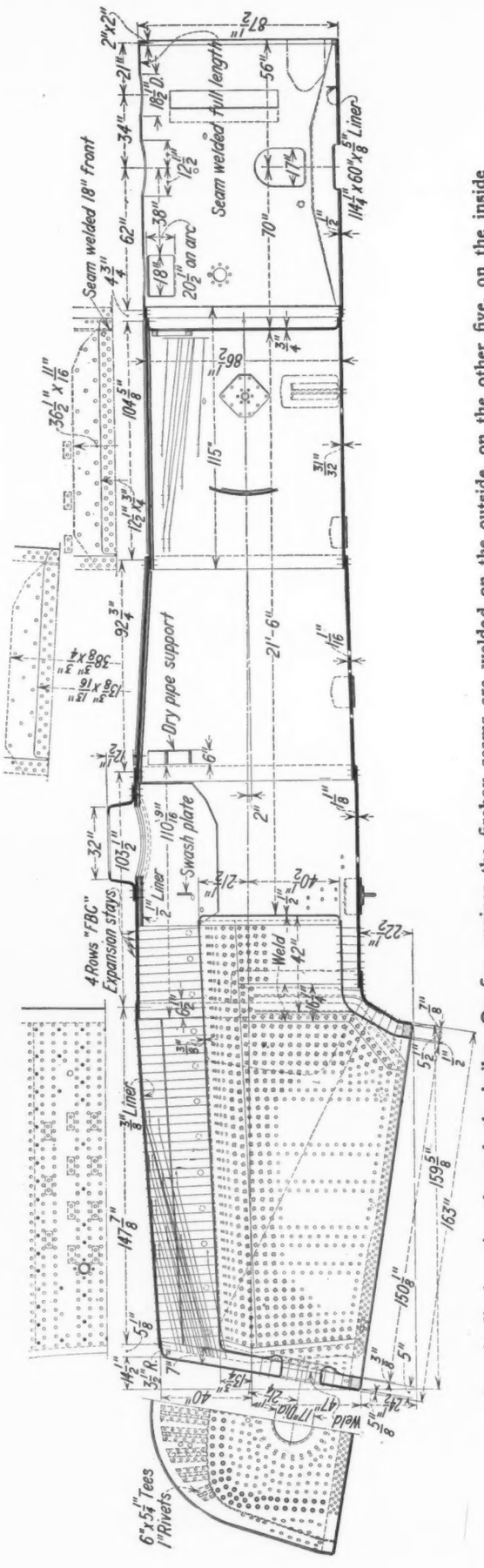
which the tongue of the articulated trailing truck is secured by an 8-in. hinge pin. Continuity of the alignment of the main frames and the trailer frame in every respect except lateral turning is secured by the bearing of the top rail of each main frame upon a sliding surface on the hinge extension of the trailer frame, and by supporting the rear end of the firebox directly on the rear end of the trailer frame through combined expansion and lateral motion roller bearings, one on each side of the locomotive.



The cast steel cylinders, showing one of the outside exhaust passages and a back valve chamber head

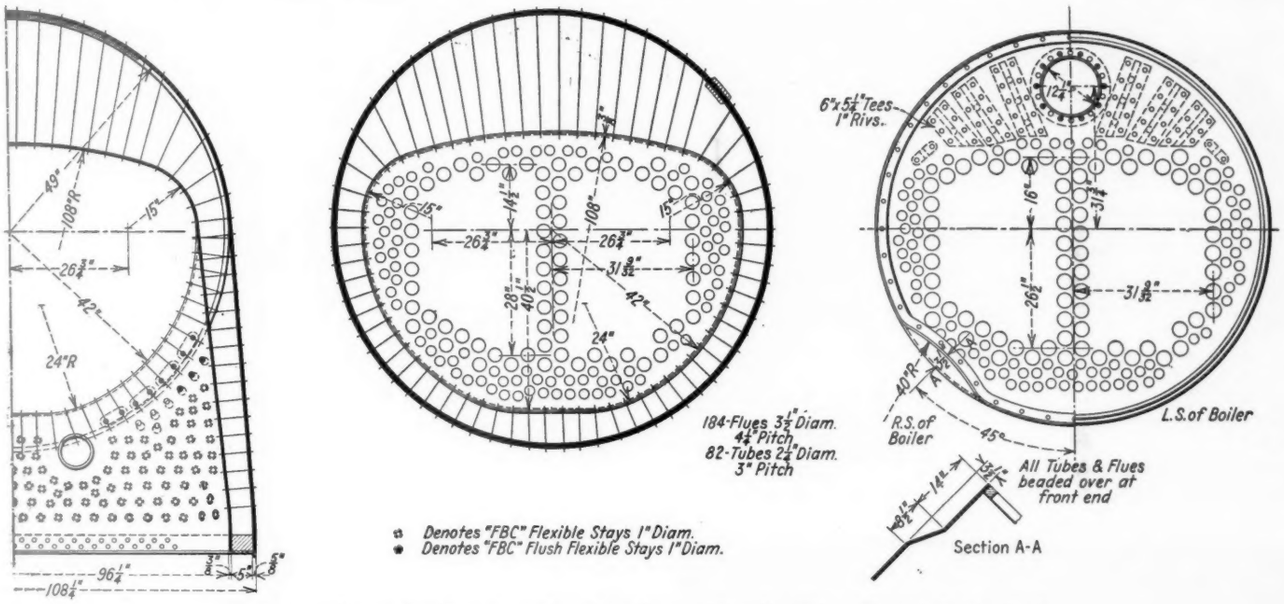
The front end of the firebox is supported from the rear end of the main frames by buckle plates.

The five pairs of drivers are continuously equalized on each side of the locomotive, starting from a fixed point back of each rear driver, and are cross-equalized with the engine truck. Each side of the trailing truck is equalized as a unit. This is the same system of equalization as that of the Lima A-1.



Longitudinal section through the boiler—On five engines the firebox seams are welded on the outside, on the other five, on the inside

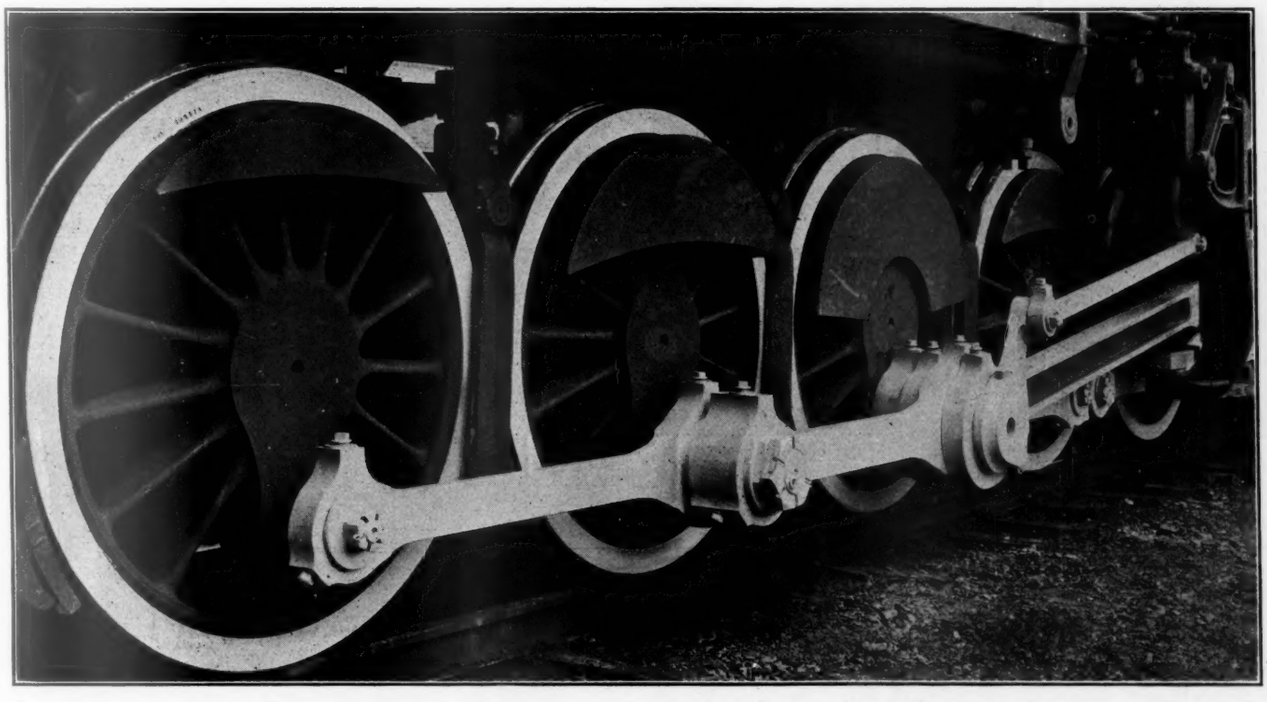
The trailer frame of the Texas type locomotives is a one-piece steel casting, the front end of which forms the hinge and in the rear end of which is incorporated the pocket for the Unit drawbar between the engine and tender and on which is mounted the Radial buffer. This casting is shown in one of the photographs.


184-Flues 3½" Diam. 4½" Pitch
82-Tubes 2¼" Diam. 3" Pitch
Denotes "FBC" Flexible Stays 1" Diam.
Denotes "FBC" Flush Flexible Stays 1" Diam.
6"x5½" Tees 1" Rivs.
R.S. of Boiler
L.S. of Boiler
All Tubes & Flues beaded over at front end
Section A-A

Boiler sections, showing the tube sheet layout for the Type E superheater units

The cab is supported on cast steel arms which are bolted to the rear corners of the mud ring and in which are incorporated the top members of the expansion and lateral motion bearings. The wind sheet extending down from the rear end of the cab deck is divided into two parts so that by the removal of the lower sheet it is possible to run the trailer truck out from under the locomotive without lifting the rear end of the boiler more than enough to relieve the trailer of its load. The booster, which drives on the rear pair of trailing wheels, is supported from the truck frame by a yoke casting behind the wheels.

The five pairs of drivers are driven by articulated main rods of the type used on the A-1, driving on the third and fourth crank pins. Side rods distribute the load from the third pair forward to the second and first, and to the rear from the fourth to the fifth. An interesting feature of the rod arrangement is the setting out of the back side rod pin bearings 3 in. from the face of the wheels, the increased clearance thus provided being used to bring the center of gravity of the counterbalance of the fourth and fifth wheels out nearer to the plane of the

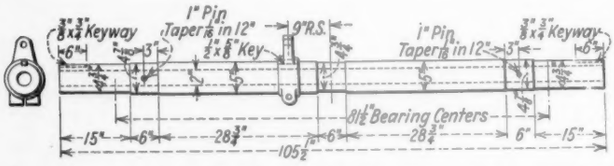


The articulated main rod connection between the third and fourth driving wheels

Longitudinal section through the boiler—On five engines the firebox seams are welded on the outside

reciprocating parts. The forward driving axle is fitted with lateral motion driving boxes designed to provide a total lateral movement of 1½ in.

The material in the main and side rods is normal carbon-vanadium steel. The piston rods and crank pins are of chrome-vanadium, heat treated, the main crank pins being hollow-bored and the others solid. The piston



The reverse shaft is five inches in diameter, with a two-inch hollow bore

centers are Carnegie rolled steel fitted with Hunt-Spiller gun iron bull rings and packing rings.

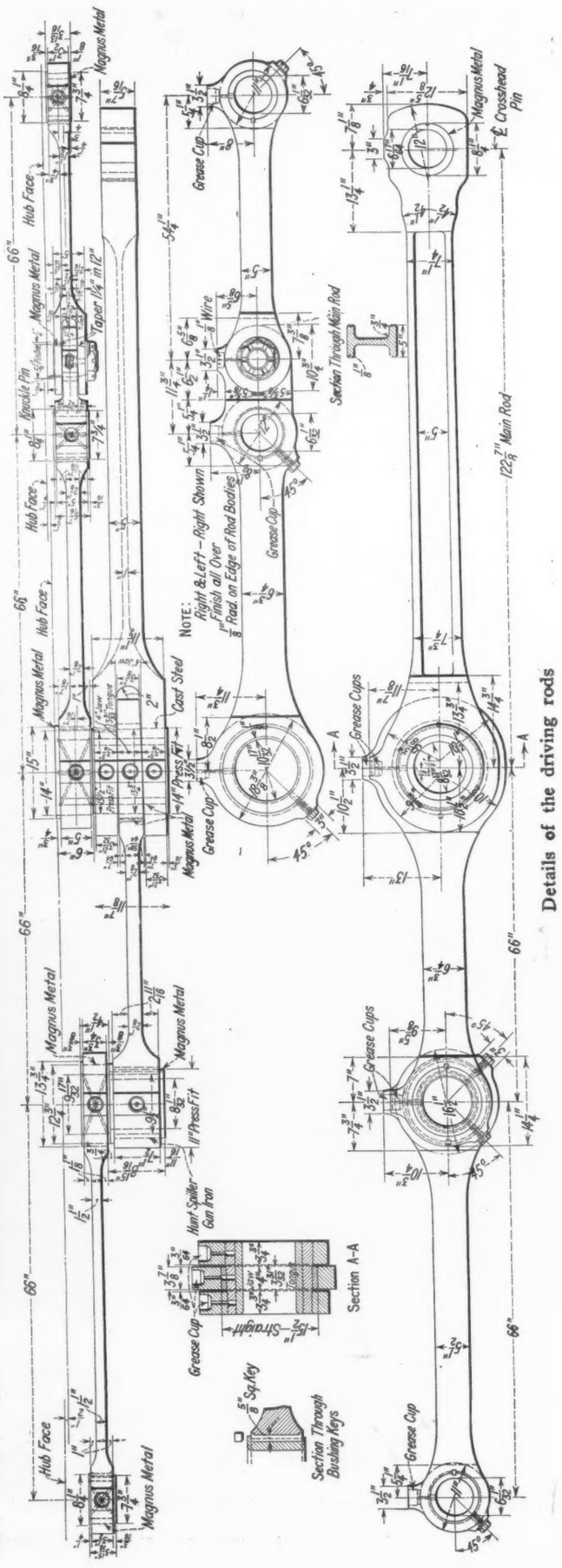
Lubrication and auxiliary equipment

The cylinders receive lubrication from three sources. The principal source is a Nathan Type DV force feed lubricator, the four feeds of which deliver oil to the cylinders and the valve chambers. A Nathan five-feed hydrostatic lubricator is provided for the air pump, the

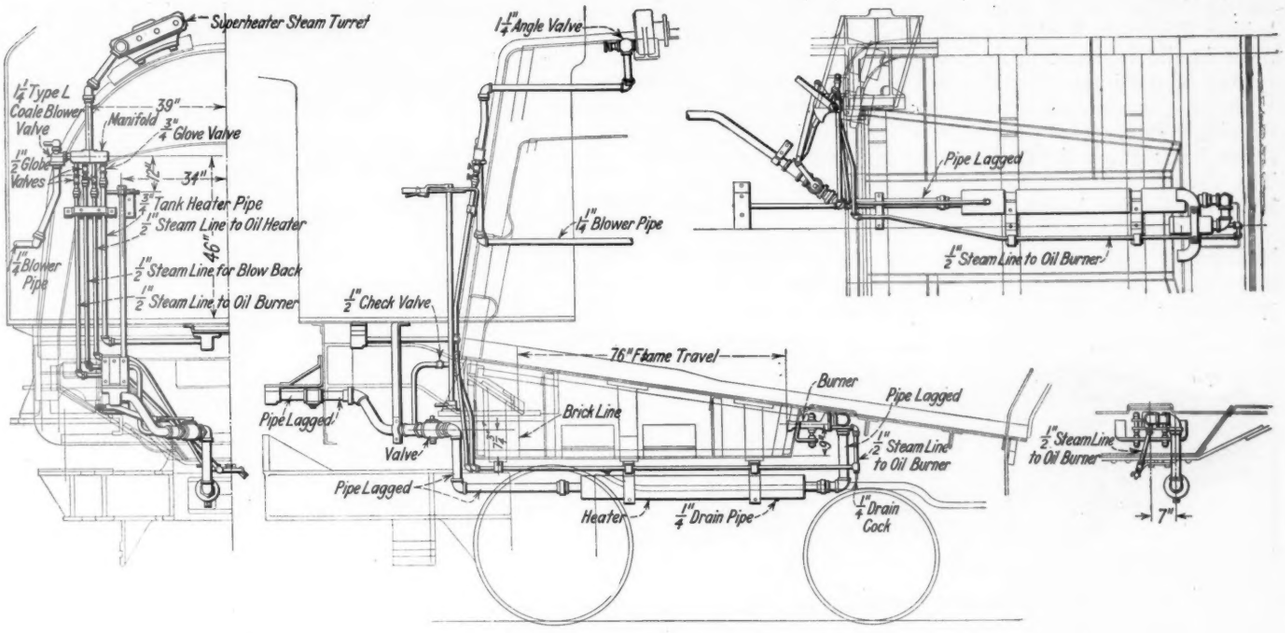
The fireman's side of the cab, showing the wardrobe locker

feedwater pump and the booster. The other two feeds are connected to the steam pipes as high above the cylinders as the fittings can be conveniently applied. In addition to these lubricators, a National Graphite Company pendulum type graphite lubricator is fitted in the neck of the superheater header where the saturated steam enters.

Superheated steam is carried back from the superheater header to a superheated steam turret on the left side of



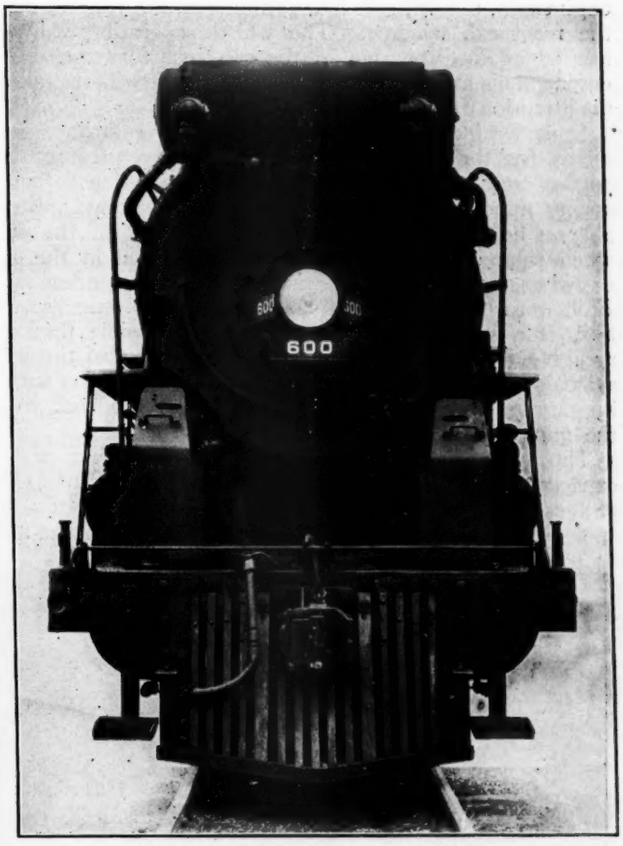
Details of the driving rods



General arrangement of the oil burning equipment

the boiler just in front of the cab. This header furnishes steam to the air pumps, the feedwater pump, the headlight generator, the blower and the fuel oil heaters and atomizer. The whistle, which also uses superheated steam, is located well forward on the boiler alongside of the bell. The whistle fitting is welded directly on the superheated steam pipe which feeds the turret. The sound of the whistle is increased in volume and sharpness by the use of superheated steam, and this location—made possible by the use of the Parsons pneumatic operating rigging—protects the occupants of the cab from the unpleasant effect of this sound at close range. Placing the whistle well forward

The engineman's seat is spring suspended and folds back—The whistle valve is shown on the side of the cab at the front of the arm rest

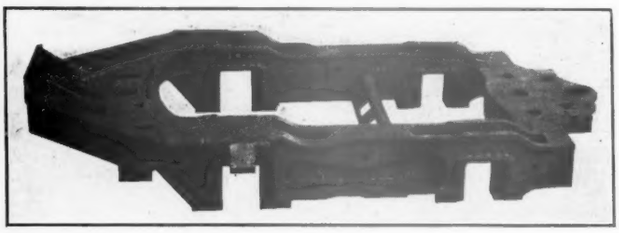


Front of the T. & P. locomotive, showing the location of the two cross compound air compressors

on the boiler and to one side, where it is not directly behind the stack, is also expected to effect some improvement in the forward projection of the sound.

One of the interesting details on this locomotive is the Unit pipe clamp and bracket for the main reservoir and running board. This provides a secure anchor for holding three lengths of air radiator pipe above the reservoir. The clamps are securely held by the same bolts which hold the running board in place.

One of the photographs shows the arrangement of the back boiler head fittings in the cab. It will be seen that great care has been exercised in arranging the control apparatus where it is conveniently accessible to the engine-



The trailer frame casting

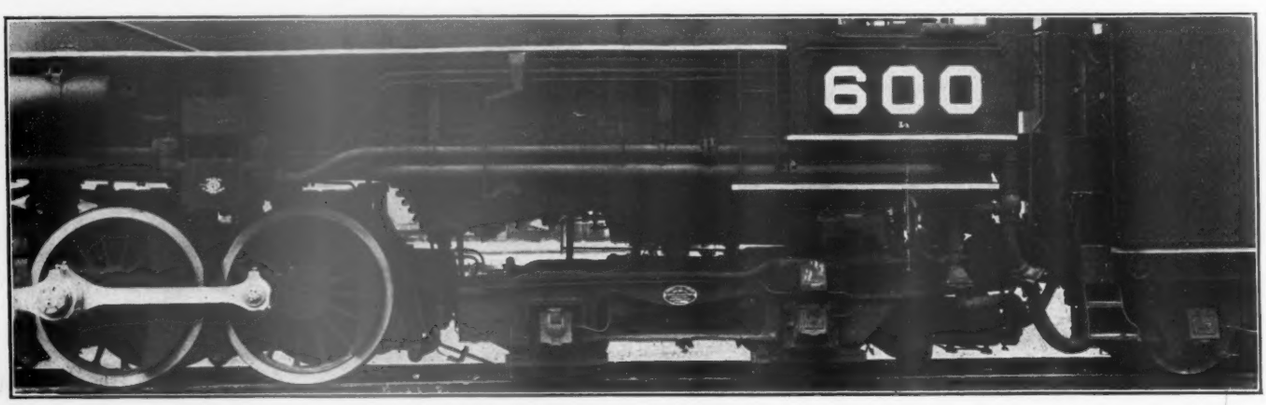
man and will not interfere with his movement to or from his seat. The water glass, the hydrostatic lubricator, the various pressure gages and the Boyer speed recorder dial have all been grouped and disposed where they can be seen at a glance, most of them directly in front of the engineman, but without interfering with his view through the front cab window. The whistle operating valve is located against the side of the cab just forward of the engineman's arm rest where he can press it without taking his attention from the track.

Considerable attention has also been given to arrangements for the personal convenience and comfort of the engine crew. The engineman's seat in addition to being spring upholstered, is also spring supported and adjustable in height. It may be folded back out of the way when room is needed by workmen employed in the cab or when the engineman wishes to work standing up. Built onto the wall of the cab back of the fireman's seat box, is a wardrobe locker. This is accessible through a high door back of the fireman's seat and also through a small door at the bottom in the gangway. An ample luggage rack is also provided under the cab roof over the gangway.

The locomotives are served by tenders with a water capacity of 14,000 gallons and a fuel oil capacity of 5,000 gallons. The tanks are of the Ralo-Acme type of construction, carried on Commonwealth cast steel frames and two Commonwealth six-wheel trucks. The tender has been designed to permit the application of a stoker with a minimum of alterations should it later become desirable to convert the locomotives from oil-burning to coal-burning service.

The principal dimensions and proportions of these locomotives are given in the following table:

Railroad	Texas & Pacific
Type of locomotive	2-10-4
Service	Freight
Cylinders, diameter and stroke, in.	29 by 32
Valve gear, type	Baker
Valves, piston type, size	14 in.
Maximum travel	8¾ in.
Steam lap	2 1/16 in.
Exhaust clearance	1/8 in.
Cut-off in full gear, per cent	60
Weights in working order:	
On drivers	300,000 lb.
On front truck	41,800 lb.
On trailing truck	106,200 lb.
Total engine	448,000 lb.
Tender	275,200 lb.
Wheel bases:	
Driving	22 ft.
Rigid	16 ft. 6 in.
Total engine	46 ft. 8 in.
Total engine and tender	86 ft. 8 in.
Wheels, diameter outside tires:	
Driving	63 in.
Front truck	33 in.
Trailing truck	36 in. and 43 in.
Journals, diameter and length:	
Driving, main	13 in. by 14 in.
Driving, others	11 in. by 13 in.
Front truck	7 in by 12 in.
Trailing truck	6½ in. by 12 in 9 in. by 14 in.
Boiler:	
Type	Taper course
Steam pressure	250 lb.
Fuel, kind	Oil
Diameter, first ring, outside	86½ in.
Firebox, length and width	150⅛ in. by 96¼ in.
Height mud ring to crown sheet, back	60¾ in.
Height mud ring to crown sheet, front	93 in.
Arch tubes, number and diameter	2 Syphons
Combustion chamber length	42 in.
Tubes, number and diameter	82—2¼ in.
Flues, number and diameter	184—3½ in.
Length over tube sheets	21 ft. 6 in.
Grate area	No grate
Heating surfaces:	
Firebox and comb. chamber	3,755 sq. ft.
Syphons	98 sq. ft.
Tubes and flues	4,640 sq. ft.
Total evaporative	5,113 sq. ft.
Superheating	2,100 sq. ft.
Comb. evaporative and superheating	7,213 sq. ft.
Tender:	
Style	Rectangular
Water capacity	14,000 gal.
Fuel capacity	5,000 gal.
Rated tractive force	83,000 lb.
Rated tractive force, incl. booster	96,000 lb.
Weight proportions:	
Weight on drivers ÷ total weight engine, per cent	67.0
Weight on drivers ÷ tractive force	3.62
Total weight engine ÷ comb. heat. surface	62.1
Boiler proportions:	
Tractive force ÷ comb. heat. surface	11.5
Tractive force × dia. drivers ÷ comb. heat. surface	725.
Firebox heat. surface ÷ grate area	4.73
Firebox heat. surface, per cent of evap. heat surface	9.26
Superheat. surface, per cent of evap. heat. surface.	41.1



The firebox and articulated trailing truck

Some suggestions for future locomotive development

Electric control of steam distribution—Multi-cylinder construction provides smooth torque

By William A. Newman

Mechanical engineer, Canadian Pacific, Montreal, Que.

Part I

UP to within the past few years, the development of the steam locomotive has been along the lines of a natural increase in capacity, weight and refinement of details. At the present time, we find that through normal growth, the modern locomotive in America has just about reached its ultimate stage of development as regards physical restrictions of height, width and length. The weight factor is also becoming one of extreme seriousness, with the continued increase in loads on the axle.

The present trend of development still appears to be along the lines of further increases in capacity, together with improvements in operating and fuel efficiency. Efforts in this direction are in the main still centered on refinement and changes in details of construction, together with the addition of auxiliary equipment and appliances. In Europe and to some extent in America, there is also a considerable tendency towards experiments with new forms of power application such as the steam turbine and both the indirect and direct drive Diesel locomotive, a few of which are in actual operation.

In considering the possibilities of the locomotive of the future, possibly the electric locomotive should merit first consideration. It has many manifest and marked advantages as an operating unit, and without doubt, will be more widely used in the future than in the past. The very large initial plant and equipment investment required for electrification makes it doubtful, however, whether the use of the electric locomotive can ever be universal, as long as present first costs are maintained and further reductions in cost of transportation are still possible with more improved forms of heat engines. It would, therefore, appear logical that the future development of motive power will naturally include more refined an efficient forms of the heat engine, in view of the great possibilities for large gains in economy.

The steam turbine and Diesel locomotives are still in the development stage. The steam turbine is fundamentally a high speed unit requiring stepping down to normal axle speeds by some form of transmission, and should operate condensing for greatest economy. With existing traffic conditions in America, there can be little, if any, falling away from the present standard of high sustained tractive forces at fairly high speeds. This, in turn, calls for large horsepower development, which makes it problematical whether boiler, turbine, transmission, condenser and fuel and water storage space can in a practical way, be fitted together within existing clearance restrictions. The same statement applies to the various forms of Diesel locomotive; that is, there are serious constructional difficulties to be surmounted with the large horsepower development necessary for the high tractive efforts now demanded. One can go further and say that not only is it necessary for successful turbine and Diesel locomotives to duplicate existing accomplishments, but they must also be possible of development to meet future demands for greater capacity motive power.

The weak points of design in the modern locomotive

It would seem that the most promising line of development still remains with the reciprocating steam locomotive in whatever form it may be used. It would also appear that there is more possibility for gains in economy with the use of steam than with any other method of application of energy, as the present very low thermal efficiency of the steam engine leaves a margin for future savings greater than in practically any other field. It is quite within reason that some form of steam generation may skip the latent heat stage and give us steam with a very greatly reduced consumption of heat units, or that a cycle of operation be evolved that would largely eliminate the existing serious losses of the latent heat stage of the present operating cycle.

Having narrowed down the field for maximum possibilities of future development to the reciprocating steam locomotive, an analysis of the development of the present type of locomotive is next in order. Going over the manner of wheel arrangement, boiler construction and attachments, without question the modern locomotive is the same in principle as the earliest forms of successful locomotives put into regular operation. It is true that the development and refinement has resulted in a machine of excellent efficiency and suitability for American conditions, but it is also true that some marked departure from the present forms of construction must be made to continue further progress in capacity and efficiency if such is required. It is also a fact that in evolution by mere growth, we have introduced certain factors not conducive to minimum maintenance. In particular, the present size of cylinders, pistons, crossheads and rods are exceedingly difficult to handle, produce high stresses, and furthermore through the very large piston thrust, bring a tremendously concentrated load on any one part through faulty alinement or improper maintenance costs. The revival of old forms of locomotives such as the compound and the three-cylinder locomotive, cannot altogether solve the future problems, as the additional mechanical complications with little, if any, reductions in piston thrusts only increase maintenance difficulties. With all these factors disclosed, the thought presents itself, would it not be possible, for example, to go back to Stevenson's starting point, and with the wealth of engineering knowledge and experience today available, conceive a new type or form of locomotive construction that would have as great a margin of development before it, as was true of Stevenson's locomotive, "Rocket"?

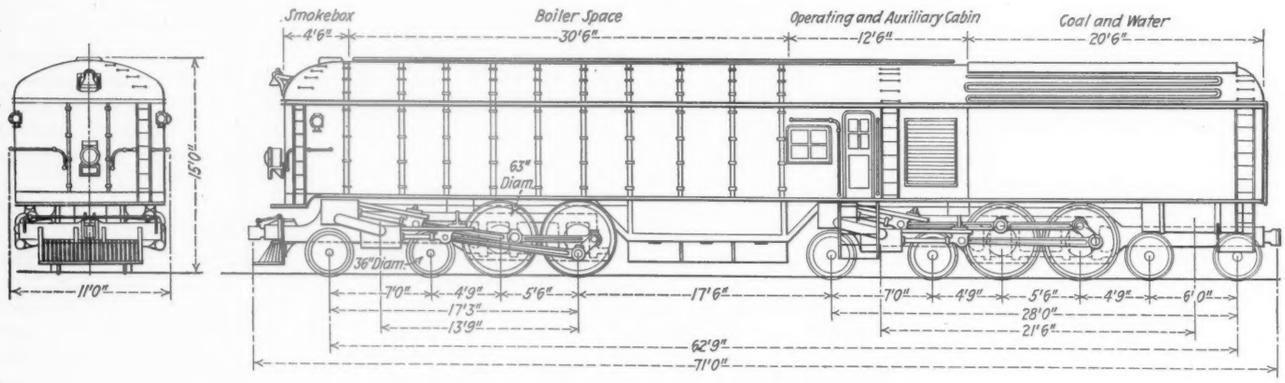
Fundamentals defined for proposed locomotive

To determine what would be possible from this standpoint, a proposed type of locomotive has been worked out

and at the outset, it must be stated that the following constitutes only a grouping of ideas, which although fairly well thought out as regards the detailed form of construction, have not been fully investigated, so that it is the ideas themselves that must be adopted or discarded on their own merits. It should also be clearly stated that the whole object in putting forward this suggested type of locomotive is to demonstrate that the possibilities of increased capacity and greater economy of the steam locomotive have by no means been exhausted.

As a starting point, two features of the electric locomotive have been adopted as permitting a wide range in flexibility of control and operation. These are: first, the electric control and operation of all auxiliaries and auxiliary devices; second, as close an approach to the constant torque of the electric locomotive as is feasible.

To accomplish the first, it is proposed to use a turbine-driven generator for the developing of sufficient current to take care of the operation of auxiliaries, the manipulation of main distributing valves and throttle and reversing controls. To obtain the second objective, it is proposed to use multi-cylinder construction. To obtain the maximum thermal efficiency, high steam pressure and high superheat are necessary and also tend to improve construction through the use of smaller parts and the greater possibilities for work production of the more highly superheated steam.



Schematic view of the proposed steam locomotive

The design of the boiler and frame

With these fundamentals defined, the selection of a form of assembly is the next step. Here boiler construction enters, and it becomes at once apparent that a revision in type of boiler is essential for the use of higher pressures and for obtaining greater steam producing capacity. The particular form of boiler to be used is more or less immaterial, in fact, it might be possible to develop a boiler along several different lines which might be perfectly capable of the development necessary to take care of the further growth of locomotive capacity. It is, however, felt that any boiler design that is now proposed will only be tentative at the best, as it is practically a certainty that radical departures in methods of steam generation will in the future open new fields of locomotive development. In order to present the form of the locomotive now proposed as a whole, one type of boiler has been worked up in which only more or less accepted forms of construction have been followed. While higher pressures will undoubtedly be used in the future, it is thought advisable to adhere to a moderate advance in pressure at the start. For this reason, 300 lb. boiler pressure is suggested.

The boiler itself is divided into two stages, the high pressure stage carrying 300 lb. In this stage pressure is confined entirely to small diameter evaporating tubes and a central storage drum, together with the necessary headers.

The low pressure stage acts as a combined secondary feedwater heat and water purifier. The low pressure side of the boiler also forms a container for the nests of evaporating and superheater tubes. Briefly, the water is first fed into the low pressure stage at 170 lb. pressure, in which the water is heated to the corresponding temperature for this pressure, and then passed into the high pressure stage where the evaporation occurs.

As the height and weight restrictions are immovable, it is imperative that the weight be used to better advantage, which is possible in multi-cylinder construction, as the adhesion necessary is reduced. The utilization of the weight of fuel and water also forms a possible means for the better use of weight. It is suggested that the locomotive construction as a whole be in the form of a main unit, consisting of the boiler, operating cabin, fuel and water storage space, with the necessary auxiliaries, etc., all mounted on one frame of which the boiler construction forms a part. This frame would be mounted on forward and rear pivoting trucks. Each truck would consist of a group of driving wheels and smaller guiding wheels with four steam cylinders to each truck or driving unit, the steam supply and exhaust for which are carried through the pivoting center, so as to reduce the angular movement to be provided for in the flexible connections. To demonstrate the possibilities of construction of this form, a moderate size locomotive has been selected which is shown to scale in one of the illustrations. This particular locomotive is suggested as a general service unit suitable for either freight or passenger requirements, as the characteristics of the proposed engine would make the size of the wheels selected suitable for moderate high speed work, as well as for heavy sustained tractive force. The various details of construction that are suggested may now best be described by an explanation of the different constructional features of the proposed locomotive which, on account of the electrical control, has been termed a thermo-electric locomotive.

Forward and rear driving units

The forward driving unit consists of two pairs of drivers with one four-wheel guiding truck. The rear driving unit is a duplicate of the leading, with the exception that a four-wheel trailing truck is used as well as the four-wheel guiding truck. The exhaust from the forward cylinders is emitted directly through the stack, whereas the exhaust from the cylinders of the rear unit is led into the water storage space, and partially utilized for feedwater heating. Outside of the foregoing differences, both trucks are alike in all details, and the parts are largely interchangeable.

The frames are cast with both sides integral with cross ties and bracing, similar to what has been done on recent electric locomotives, to give maximum strength with minimum weight. In each driving unit the two pairs of drivers are driven by four cylinders, all cylinders being mounted on the outside of the frames. The upper pair of cylinders drives the first driving wheels and the lower pair the second driving wheels. The upper cylinder drives direct on a main crank pin, such as is used in customary locomotive practice. The lower cylinder drives on a crank pin carried on a return crank, the inner portion of the return crank serving as a bearing for the side rod connecting the two pairs of drivers together. This return crank with both inner and outer bearings is constructed from a solid forging pressed and keyed directly in the driving wheel center. The cylinders, to develop a tractive effort of 71,400 lb., are 13 in. in diameter with a 26-in. stroke. These take up a very small amount of room compared with modern practice, and together with the use of frames cast integral, will permit the use of four wheel trucks having outside bearings which allow the use of standard A. R. A. axles and journal boxes, etc., which should materially assist in engine truck maintenance.

The small cylinders, even with 300 lb. pressure, give a comparatively small piston thrust judged by modern standards, which in turn gives much smaller piston heads, piston rods, crossheads, main rods, and crank pins, all of which will greatly reduce concentrated loads and stresses caused by rotating and reciprocating weights.

The introduction of four pairs of cylinders on the complete locomotive would, at first glance, appear to be prohibitive on account of valve gear complications. Here, however, it is proposed that electrical energy be used to control the movement of the valves, and thereby provide a greatly simplified arrangement as compared with the present types of valve motion. The cylinders themselves, on account of the small volume, require comparatively small valve openings, which in turn will permit the use of considerably over-size valves to permit a freer flow of steam than is possible with present conditions. The valves themselves may be either of the poppet or piston type, and in the proposed locomotive, the piston type of 6-in. diameter are proposed. The valve spindle projects through the customary type of packing and the valve itself is actuated by an electro magnet operating against helical spring pressure. Separate admission and exhaust valves are used so that the arrangement becomes very similar to what is used in internal combustion engines wherein spring pressure is used to seat a poppet valve, after it has been mechanically opened. The energizing of the electro magnets is accomplished by moving contact points carried on a rotor keyed on either one of the main axles between the frames. The moving contact points make and break the contact with the segments of a commutator ring fixed concentrically with the rotor and free to move vertically up and down, but not capable of rotating relatively to the rotor. The segments on 180 deg. of the commutator represent a cut-off from zero to 100 per cent and control the flow of steam in one end of one cylinder, and in the opposite end of the corresponding cylinder on the opposite side of the engine, these cranks being set 180 deg. apart. The remaining 180 deg. of the commutator controls the steam flow in the opposing ends of the same pair of cylinders.

The cut-off is adjusted by having a control lever in the operating cab, which moves on a segment, the forward half of which represents the forward cut-off, and the rear half, the reverse motion. Each half is divided into contact points coinciding with the divisions on the 180 deg. of the fixed commutator rings surrounding the contact rotors on the axles. Connections are so arranged that contact is made at the fixed lead point and broken at the segment at which the control lever is placed in the cab. Exhaust valve release and the closures are controlled by fixed contact points independent of cut-off changes.

By operating the control lever on the reverse section of the control quadrant, the magnet connections are reversed, thereby changing the valve movement just as in an ordinary mechanical valve motion.

To prevent arcing as the electro magnets come in or out of play a high resistance shunt is employed so that current is always flowing in the electro magnet circuit, thereby preventing damage to contact points.

This explains the general principle proposed, the control of all cylinders being worked out similarly, one compound rotor and stationary commutator serving for each power truck.

The advantages of such a system are many. In the first place, almost instantaneous valve action is obtained, the movement of the valves being many times faster than the fraction of time in which a very small angular movement of the driving wheels occurs. This means that under all conditions the valve is fully opened from zero to 100 per cent cut-off, and that a free and uninterrupted flow of steam is thereby insured. Then, too, the cut-off action will be much crisper. With the cut-off of the current, the strong spring action will give a slower, though still practically instantaneous valve closure. If necessary, magnetic force can also be used to produce the closure of the valves.

The lubrication of the valves and cylinders is effected by a force feed lubricator mounted on the engine frame, gear driven by a small size enclosed weatherproof electric motor, so connected electrically that it cuts in when the locomotive starts and cuts out when the locomotive stops. If desired, it can also be arranged so that the amount of oil feed can be registered electrically in the cab so that the engineman will have complete knowledge of the amount of lubricant being fed to cylinders on both the front and rear driving units. It is proposed to bring down through the center plate connection the steam supply to the cylinders, together with the exhaust, which will be of comparatively large diameter. The exhaust and live steam will be carried in separate passages so arranged that there will be only one flexible joint for live and one flexible joint for exhaust steam. Outside of these joints, no mechanical connections between the driving units and the main portions of the locomotive are required. There will be only air connections of the usual type and electric cable connections so arranged that the detachment of the driving unit from the main frame can be quickly and readily carried out to facilitate shop repairs.

The tractive force exerted by the leading truck will be taken up on special roller radial thrust bearings surrounding the forward center plate, which means that the locomotive body would be called on to transmit the tractive force of the leading driving unit backwards to the rear driving unit, which would carry the draft gear and coupling arrangements.

(To be concluded in the February issue)

THE AVERAGE COST per ton of coal used as fuel for road locomotives in freight and passenger train service, charged to operating expenses, for Class 1 railways in October, 1925, was $2.06 as compared with $2.85 in October, 1924, according to the Interstate Commerce Commission's monthly bulletin. Fuel oil cost 3.12 cents in October, 1924. The total cost of coal and fuel oil for the month was $30,293,706, as compared with $29,888,414 in 1924. For the ten months ended with October the average cost of coal was $2.73, as compared with $3.08 in 1924. Oil cost 3.18 cents as compared with 2.78. The total cost of coal and fuel oil was $271,728,983, as compared with $295,671,213 in 1924. For coal alone the total cost was $217,334,932, as compared with $247,866,834.

Annual report of the Bureau of Locomotive Inspection

Forty-six per cent of the locomotives inspected were found defective — Improvement over preceding years

THE fourteenth annual report of the chief inspector of the Bureau of Locomotive Inspection to the Interstate Commerce Commission for the year ending June 30, 1925, again emphasized the fact that the autogenous welding of parts of the locomotive or tender, where through the failure of such parts there is a possibility of accident and injury to persons, had not yet reached the stage in its development where it could be used with safety. In the thirteenth annual report, an abstract of which was published in the January issue of the *Railway Mechanical Engineer*, attention was directed to accidents investigated where welds made by the autogenous process were involved. It was stated in that report that approximately 78 per cent of autogenously welded seams involved in firebox failures were torn, while only 15.4 per cent of riveted seams involved had

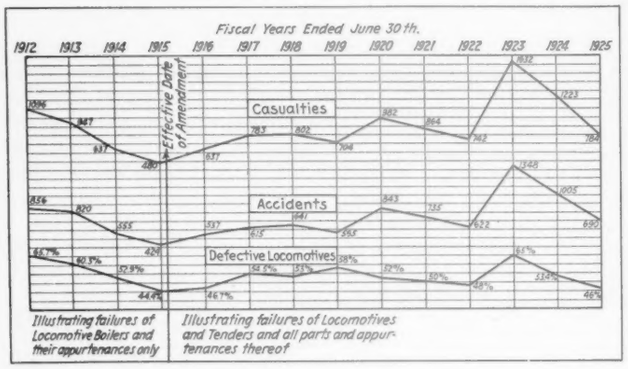
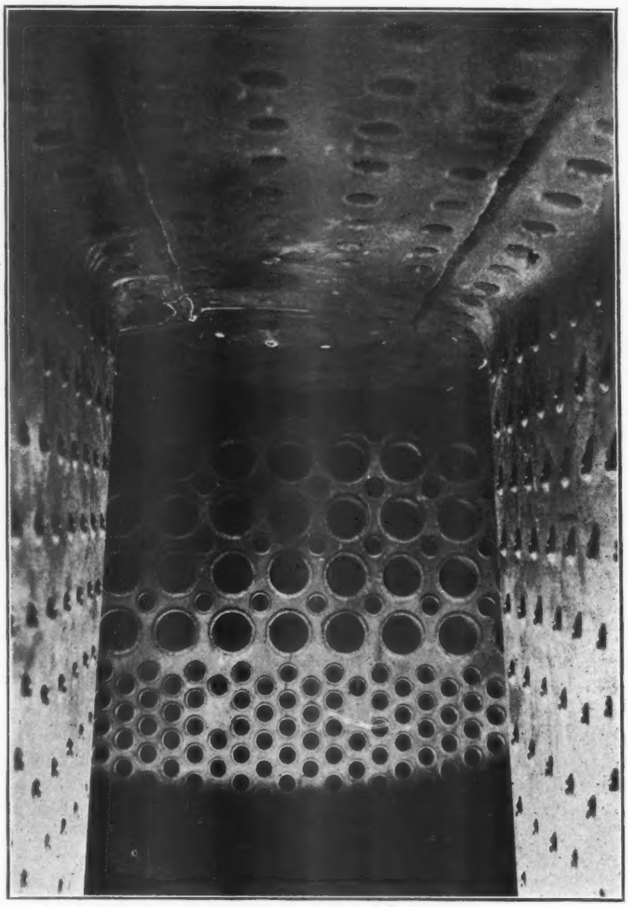

Fiscal Years Ended June 30th.
1912 1913 1914 1915 1916 1917 1918 1919 1920 1921 1922 1923 1924 1925
Effective Date of Amendment
Casualties
Accidents
Defective Locomotives
Illustrating failures of Locomotive Boilers and their appurtenances only
Illustrating failures of Locomotives and Tenders and all parts and appurtenances thereof

Chart showing the relation of defective locomotives to accidents and casualties resulting from locomotive failures

failed. This report pointed out that from July 1, 1915 to June 30, 1924, autogenously welded seams were involved in 26.9 per cent of the crown sheet failures, while 50.7 per cent of the persons killed in such accidents were killed in cases where the autogenously welded seams were involved. During the 12 months' period covered by the fourteenth annual report, numerous other accidents of the same or similar nature have occurred, views of some of which are shown in the illustrations.

The present report contains a summary of all accidents and casualties occurring during the year ending June 30, 1925. A total of 690 accidents occurred in the 12 months' period covered by the report, a decrease of 31.3 per cent from the number shown in the preceding period. With the exception of the 12 months' period for 1921 and 1922, this is the lowest number of accidents reported since 1920. There were 20 persons killed during the period covered by this report as compared with 33 killed in 1921-22, the lowest number of fatalities previously reported since 1920.

The greatest number of accidents was due to defective grate shakers of which there were 57. Fifty-three accidents were due to defective squirt hose, 49 to defective reversing gears, 36 to defective flues and 31 to defective brakes and brake rigging. Three fatalities were caused by defective brakes and brake rigging, which stands second in the list of appurtenances causing fatal accidents. The greatest number of deaths were caused by boiler ex-

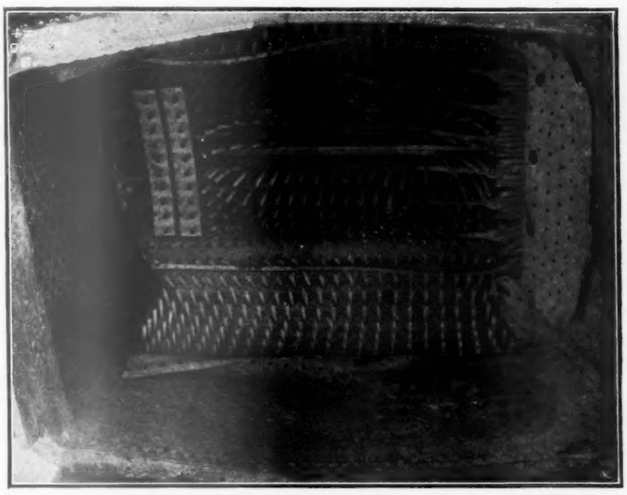


Crown sheet damaged on account of low water—The two thermic syphons discharged sufficient water to keep part of the crown sheet from becoming overheated

plosions. Twelve persons were killed by boiler explosions, 10 crown sheet failures on account of low water and two were due to defective staybolts in the firebox. An abstract of the report follows:

A summary of all accidents and casualties to persons occurring during the year ending June 30, 1925, as compared with the previous year, covering the entire locomotive and tender and all of their parts and appurtenances, shows a decrease of 31.3 per cent in the number of accidents, a decrease of 69.7 per cent in the number

of persons killed and a decrease of 33.9 per cent in the number injured during the year. There was also a substantial decrease in the percentage of locomotives, inspected by our inspectors, found defective as compared with the previous year. During the year 46 per cent of



Approximately 23 ft. of autogenously welded seams in this firebox failed at the time the boiler exploded

the locomotives inspected were found with defects or errors in inspection that should have been corrected before being put in use, while during the previous year, 53.4 per cent of those inspected were found defective.

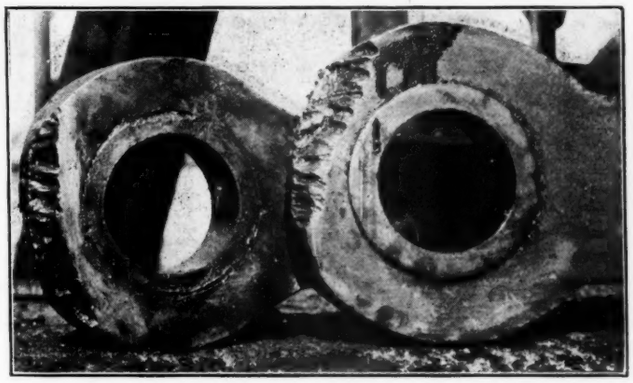
Derailments due to defects in or failure of some part of the locomotive or tender

	1925	1924	1923	1922	1921
Number of derailments*	22	30	38	22	8
Number of persons killed	..	3	4	5	..
Number of persons injured	52	112	157	61	30

*Only derailments reported by carriers as being caused by defect in or failure of parts of the locomotive or tender were investigated or counted.

While there was a substantial decrease in the total number of accidents occurring during the year, our investigation shows that a still greater decrease should have resulted had the requirements of the law and rules been complied with, especially so with respect to parts and appliances which are sometimes considered unimportant. Special attention is directed to the reduction in the number of boiler explosions caused by low water during the year. Boiler explosions are the most prolific source of serious and fatal accidents with which we have to deal, therefore, during the course of our regular work, special attention has been given to conditions which contribute to such accidents. A great deal of consideration has been given to the action of the water in the boiler and its effect upon the water indicating appliances and the result of our study in this matter has been brought to the attention of those in charge of locomotive maintenance and operation, as well as those actually operating locomotives. The reduction in the number of crown-sheet failures as shown is no doubt largely brought about as the result of our study with respect to the circulation of the water in the boiler and its effect upon water glasses and especially upon gage cocks when screwed directly into the boiler, and to our action in insisting that water indicating appliances and other parts, which may contribute to such accidents, be maintained to a high degree of perfection so that they will perform their functions in a proper manner.

One of the tables shows the various parts and appurtenances of the locomotive and tender which through failure have caused serious and fatal accidents, which if



Two side rods burned off at the ends with a torch to provide clearance—The Bureau considers such methods unsafe

taken advantage of and proper inspections and repairs are made in accordance with the spirit and intent of the law and rules, a large portion of such accidents can be avoided. The graphic chart shows the relation between the percentage of defective locomotives and the number of accidents and casualties to persons resulting from the failure thereof, and illustrates the effect of operating locomotives in a defective condition from the viewpoint of safety.

Persons killed and injured, classified according to occupations

	1925		1924		1923		1922		1921	
Members of train crews:	Killed	Injured	Killed	Injured	Killed	Injured	Killed	Injured	Killed	Injured
Enginemen	8	230	19	330	19	484	11	213	15	237
Firemen	6	300	22	434	16	597	10	277	25	360
Brakemen	2	84	9	102	12	137	7	66	13	64
Conductors	..	25	2	39	1	35	...	25	2	20
Switchmen	..	23	1	29	2	32	1	13	3	15
Roundhouse and shop employees:										
Boilermakers	..	6	1	24	3	19	1	10	1	7
Machinists	..	13	1	9	2	14	...	9	1	3
Foremen	..	...	1	6	1	6	...	1	1	3
Inspectors	..	2	1	3	...	2	...	2	...	5
Watchmen	1	3	...	5	1	6	...	3	...	4
Boiler washers	..	5	2	5	1	9	...	1	...	7
Hostlers	..	16	...	14	...	31	...	10	...	8
Other roundhouse and shop employees	..	10	6	34	4	29	1	15	1	25
Non-employees	2	34	...	16	4	36	2	23	2	16
Other employees	1	13	1	107	6	123	...	41	...	21
Total	20	764	66	1,157	72	1,560	33	709	64	800

Autogenous welding

In the thirteenth annual report, attention was directed to accidents investigated where welds made by the autogenous process were involved. During the year, numerous other accidents of the same or similar nature have

occurred, our investigation of which serves to establish the soundness of our recommendation, previously announced, that this process has not yet reached a state of development where it can be safely used on parts of the locomotive or tender where through failure of such parts accident and injury to persons might result.

Extension of time for removal of flues

During the year ending June 30, 1925, 146 applications were filed for extension of time for the removal of flues, as provided in Rule 10. Our investigation disclosed that in 14 of these cases, the conditions were such that no extension could properly be granted. Fourteen were in such condition that the full extension requested could not be authorized, but an extension for a shorter period of time was allowed. Nineteen extensions were granted after defects disclosed by our investigation had been repaired. Eighteen applications were canceled for various reasons. A total of 100 applications were granted for the full period requested.

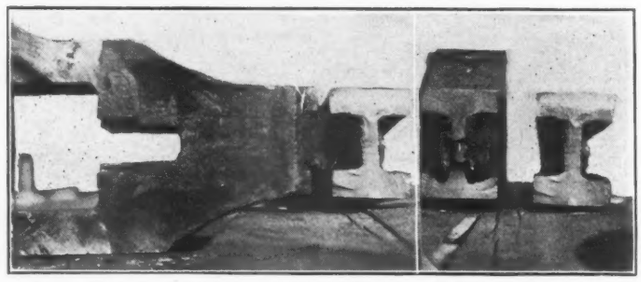
Number of locomotives reported, inspected, found defective, and ordered from service

Parts defective, inoperative or missing, or in violation of rules	1925	1924	1923	1922
Air compressors	1,574	1,221	1,390	971
Arch tubes	198	272	468	151
Ash pans or mechanism	216	257	306	161
Axles	14	19	21	15
Blow-off cocks	825	965	1,578	975
Boiler checks	991	1,329	1,913	949
Boiler shell	1,597	2,103	2,370	1,598
Brake equipment	6,497	6,920	8,213	4,577
Cabs or cab windows	2,541	1,627	1,423	1,276
Cab aprons or decks	1,165	1,293	1,476	1,098
Cab cards	665	758	1,449	567
Coupling or uncoupling devices	447	398	634	423
Crossheads, guides, pistons or piston rods	2,922	3,577	5,527	1,920
Crown bolts	283	418	630	331
Cylinders, saddles, or steam chests	4,352	5,712	4,875	3,234
Cylinder cocks or rigging	1,801	2,376	1,745	1,201
Dome or dome caps	371	494	626	331
Draft gear	2,283	1,981	2,613	1,526
Draw gear	3,273	4,160	4,513	3,042
Driving boxes, shoes, wedges, pedestals, or braces	3,241	3,722	4,269	2,776
Firebox sheets	1,152	1,471	2,327	1,191
Flues	524	698	1,268	521
Frames, tail pieces, or braces, locomotive	2,036	2,580	2,683	2,078
Frames, tender	391	414	540	352
Gauges or gauge fittings, air	694	626	1,062	399
Gauges or gauge fittings, steam	1,809	2,026	3,075	1,595
Gauge cocks	3,081	3,835	5,895	3,275
Grate shakers	832	1,006	569	425
Handholds	2,831	2,241	1,990	1,533
Injectors, inoperative	70	94	251	94
Injectors and connections	8,064	9,985	12,406	7,741
Inspections or tests not made as required	10,436	9,740	7,419	4,114
Lateral motion	659	939	1,625	976
Lights, cab or classification	86	72	90	80
Lights, headlight	928	904	1,164	705
Lubricator or shields	704	565	566	456
Mud rings	1,384	1,901	2,711	1,598
Packing nuts	2,761	3,304	4,755	3,151
Packing, piston rod and valve stem	2,411	3,187	3,359	1,756
Pilot or pilot beams	832	967	1,294	679
Plugs or studs	849	1,026	857	443
Reversing gear	1,274	1,217	1,272	789
Rods, main or side, crank pins or collars	4,813	6,507	10,080	3,915
Safety valves	234	188	192	162
Sanders	2,004	1,806	1,857	1,165
Springs or spring rigging	5,532	6,335	7,911	5,497
Squirt hose	1,008	1,221	1,098	935
Staybolts	741	916	1,313	722
Staybolts, broken	3,745	5,320	10,089	4,261
Steam pipes	1,590	2,305	2,467	1,461
Steam valves	869	981	1,168	791
Steps	2,867	2,829	3,289	2,038
Tanks or tank valves	3,352	3,393	3,788	2,817
Telltale holes	451	620	715	630
Throttle or throttle rigging	2,403	2,868	2,633	1,880
Trucks, engine or trailing	2,966	3,425	3,899	2,467
Trucks, tender	5,372	5,977	3,714	2,551
Valve motion	1,250	1,269	1,761	710
Washout plugs	3,588	3,204	3,641	2,449
Water-bars or combustion flues	19	18	24	57
Water-glass, fittings, or shields	3,713	4,201	5,641	3,640
Wheels	2,148	2,996	4,371	2,410
Miscellaneous—Signal appliances, badge plates, brakes (hand)	1,510	1,342	972	403
Total number of defects	129,239	146,121	173,840	101,734
Locomotives reported	70,361	70,683	70,242	70,070
Locomotives inspected	72,279	67,507	63,657	64,354
Locomotives defective	32,989	36,098	41,150	30,978
Percentage inspected found defective	46	53	65	48
Locomotives ordered out of service	3,637	5,764	7,075	3,089

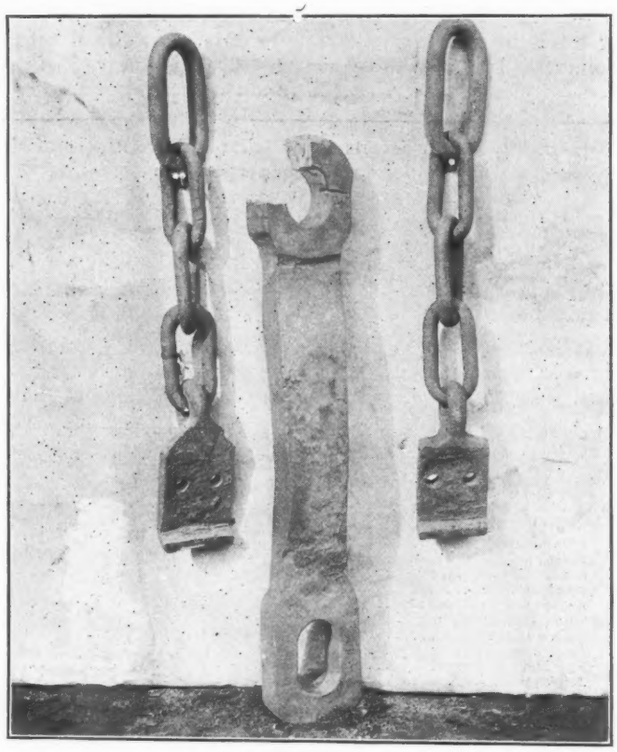
No formal appeal was taken from the decisions of any inspector during the year.

Amendment to the law

The act of June 7, 1924, further amending the locomotive inspection law extended our jurisdiction to all locomotives and tenders, their parts and appurtenances, used or permitted to be used on the line of a common carrier subject to the Interstate Commerce Act, which includes locomotives propelled by electricity, gasoline, compressed air, or other means, whereas prior to this amendment, the law applied only to steam locomotives used by common carriers subject to the law. The amendment of June 7, 1924, also provided for the appointment of 15 additional inspectors. This number of inspectors was appointed and actively engaged in the performance of their duties for an average period of three months during the year ending June 30, 1925.



Two views of a main rod that failed in service—This rod had been built up by autogenous welding



Drawbar and safety chains which failed because of crystallization of the drawbar—The 7/8-in. bolts securing the safety chains sheared when the drawbar broke

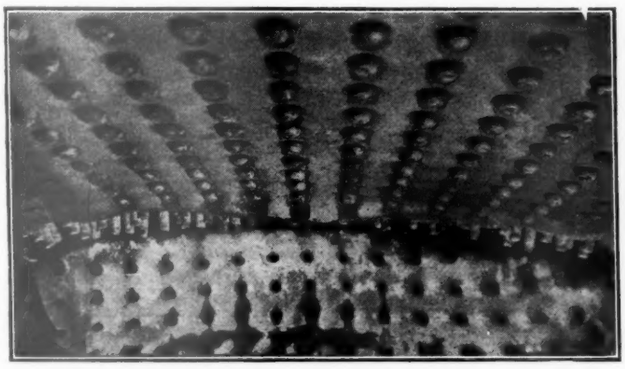
The preparation of rules and instructions fixing mini-

mum requirements for all locomotives other than those propelled by steam power is being pursued and arrangements are being made to put into effect the additional requirements as soon as possible.

The carriers having failed to file their rules and instructions for the inspection and testing of locomotives other than steam within three months after the amendment of June 7, 1924, became effective, it became my duty to prepare rules and instructions not inconsistent with the purpose of the law, which I did, in connection with which it has been deemed advisable to have a conference with the parties at interest for the purpose of coming to a common understanding so that the rules and instructions may be approved by the Interstate Commerce Commission as required by law.

Bureau asks for legal assistance in enforcing the law

A large percentage of the accidents which we have investigated were caused by defects which could have been prevented had proper inspections and proper repairs been made at the proper time. Many locomotives are allowed



Result of a crown sheet failure due to low water—Autogenously welded seam between the combustion chamber and crown sheet failed for a distance of 51 in.

to remain in use in apparent disregard for the requirements of the law, sometimes until accidents occur and many times until our inspectors find them and order them out of service. We are daily writing many letters to various carriers calling attention to their failure to comply with the requirements of the law, such as failure to make the required periodical inspections and tests and the failure to make proper repairs to defects which constitute violations of the law. With the large number of locomotives in service, scattered over such a wide area, it is apparent that Congress never intended that the law should be entirely enforced by our inspectors ordering locomotives out of service because of being in violation of the law. It is a physical impossibility for the 65 inspectors now provided to keep in sufficiently close touch with the number of locomotives coming under the jurisdiction of the law to know at all times that they are in condition to meet the requirements thereof.

Therefore, in the light of our experience, I most respectfully recommend that competent legal assistance be provided this bureau so that we may at all times have the benefit of such services in seeing that the law and the rules and regulations issued in pursuance thereof are complied with.

THE LARGEST RAILWAY LOCOMOTIVE in Australia will be built by the Victorian Railways at the Newport, Victoria, workshops. The engine is to be of the three-cylinder Pacific type, and is expected to be ready by the end of next year. It is said that the locomotive will have a tractive power of 40,000 lb.

Applied Man-Power*

By W. B. Zimmerman
Car Foreman, Lincoln, Neb.

THE record of railroad progress is that of applied science and applied man-power. Compared with other leading industries there are some who think that the railroad is a little behind the times in each; of the two, the progress of applied science has been much the more marked. We should keep pace in the progress of applied man-power. In this step the foreman is the most important man in the railroad organization. He is the key man.

Leaders are born, we often say, but it is truer to say that they are made. They are made by conditions, by the nature of efforts to be exerted, the obstacles to be overcome, the opposition to be faced, and by methods which must be used to win success. No longer should the dispenser of easy favors, the good fellow, and the champion promisor, be the chief administrator. Nor should the man who is best with his fists, who can curse the vilest, or say the most. The railroad needs leaders who can think, those who exercise candor, understanding and reciprocity. This is the needed type of foremanship.

Chief among the problems of the foreman is his management of men. He must have an increasing interest in the problem of hiring, placing, training and retaining workers and must get close to them and their problems. He must select and build up his working force, securing men willing to work and reliable, stable and co-operative. Employment should hold out a future for those who mean to stay and make good. Employment should cease to be a gamble. Incentives must be offered to make labor stable and contented, for the great turnover of labor in the past has proven very expensive. Careful study of how to conserve labor so that it will pay adequately for the investment in it, is far better than reckless hiring and firing of workers. Labor turnover is a human waste.

No place for sugar-coated pills

The railroad is not the place either for too much sentiment or too much system. A policy that is not good for the railroad is not good for the men. Labor unrest means lower output. The contact between management and men should be such as to give all concerned a feeling of security in the motives of each other. Each side must help the other, being frank in both the written and unwritten policy of the management. Misunderstanding must give way to a clearly defined policy of security. Unless this is true, labor is a necessary drudge endured for wages, or a bad tasting pill, sugar-coated by wages. Most men have a hunger for consideration, approval and eminence. This is source of gratification that, if denied to the worker, may be a greater germ of irritation than longer hours and smaller wage. He enjoys submission to the right kind of a foreman, as men always have to good kings and great leaders.

A perfect fit of work to workers cannot be guaranteed, but it is true that a job is never really filled until an employee is found who fits that job in the sense of being able to do it reasonably well and get a reasonable satisfaction from it.

Demand an honest day's work

Many foremen seem to be afraid to demand that men give an honest day's work. They fear overproduction and cut in forces. These foremen need working over. The

*Submitted in the *Railway Mechanical Engineer* competition on the foreman and his responsibilities.

labor market is once more a buyer's market and it is not necessary for the employers to cajole labor into granting an increased output. The pressure of economic forces tends to force workmen to produce more, to be steadier at work and more docile to the management. The working employee is more contented than the one who finds a little idle time. With increased taxes and numerous cuts in rates, the railroads must meet the problem of greater economy in operation. It is not a problem of giving men more work than they can do, but of demanding a personal application of every man to his job.

Foremen must analyze methods of doing work. Is each job being done right? Recently a foreman who started analyzing the jobs under him found that thirty per cent more man-hours were being used on each job than was necessary. This study saved the company ten thousand dollars a year. As we analyze the jobs it helps us match workers' abilities against the requirements of each job.

Sizing up new men

As new men are hired, the foremen should answer for himself two simple questions: "Will the applicant suit the job?" and "Will the job suit the applicant?" Getting the right person on every job, from the laborer to the president is very essential. Know the new man before he gets on the pay-roll. Too many foremen ask the applicant how many years' experience he has had, and let it go at that, having the secretary write up his application. This method is wrong. His labor policies may not be for the good. Better hand him the application blank to fill out. When this is done, ask him some questions as you read his application. Is he inclined to tell more than asked? Recently an applicant voluntarily told how he and another workman almost railroaded the foreman.

The application blank tells you about the experience of the applicant. The way he has filled out the application tells you about his education, but it takes an interview to know the applicant. This is important. True, you may dismiss a poor employee, but every turnover is expensive. If you are too busy at the moment set a definite time to interview the applicant.

In sizing up the man it is important that you learn his experience and education, his knowledge of work, general value to the company and his physical qualities.

Most railroad foremen have been much neglected so far as their training in foremanship is concerned. Most of the teaching has a tendency to become dogmatic, and the rules become bigger than the object of the rules. The adherence to rules made by small men often paralyzes a railroad's activities. Executives of the smaller caliber frequently so plan the work that it is almost impossible to perform it in the best manner. Frequent investigation shows that in railroading there are times when the initiative of the man on the job is of more value to the railroad than some of the iron-clad rules. A code elastic enough to cover any emergency should be the limitation placed on the foreman.

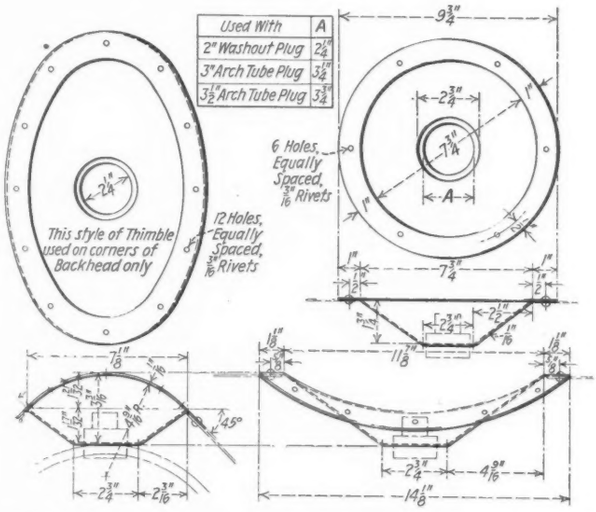
The business of the foreman is production, and the management has every right to expect it; in demanding so much of the foreman, the management must give more than the oft neglected support.

RAILROADS in Wisconsin have petitioned the Federal court at Milwaukee, Wis., for an injunction restraining the state of Wisconsin from enforcing the law, recently passed, requiring the installation of mechanical stokers on large locomotives. The mechanical stoker law was enacted by the 1925 legislature after a contest in which the passage of the bill was supported by railway labor organizations.

Jacket thimble for washout plugs

A DESIGN of jacket thimble for washout plugs which has been adopted as standard by the Union Pacific is shown in the drawing. Two styles are shown, one for application to the flat sheets on the back head and also for the slightly curved sheets on the sides of the firebox, and the other for application to the corners of the back head. These thimbles are riveted securely to the jacket.

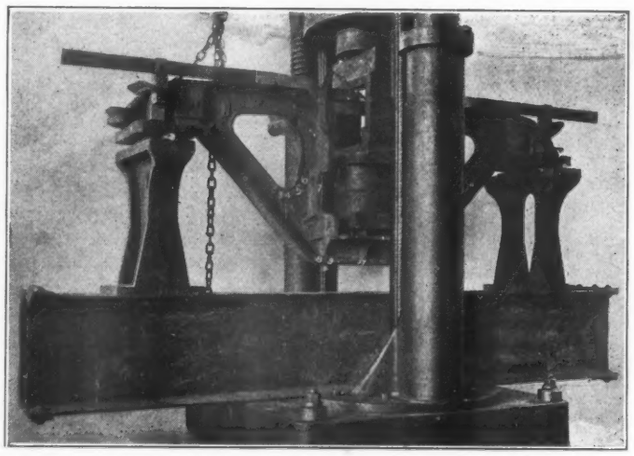
The feature of these thimbles is that they enable the workman to use either a box or open-end wrench without


Used With | A
2" Washout Plug | 2 1/4"
3" Arch Tube Plug | 3 1/2"
3 1/2" Arch Tube Plug | 3 3/4"
This style of Thimble used on corners of Backhead only
12 Holes, Equally Spaced, 3/16" Rivets
6 Holes, Equally Spaced, 3/16" Rivets
A
145°

Drawing showing the detail dimensions of jacket thimbles for backhead corners and sides of firebox

any possibility of damaging the jacket, as is quite frequently the case when the ordinary type of thimble is used.

The boiler of the Union Pacific three-cylinder 4-10-2 locomotive, No. 8000, which was described in the September, 1925, issue of the *Railway Mechanical Engineer*, page 557, is equipped with this type of thimble.



Cast steel truck side frame mounted in a 300,000 lb. testing machine at Purdue University

The tests were for the purpose of determining the character, whether tension or compression, and amount of stress in the various members of the side frame.

Examples of recent locomotives of the 4-8-2 type

Arranged in order of weight

Railroad	B. & O.	E. P. & S. W.	R. F. & P.	D. L. & W.	C. R. I. & P.	So. Pac.	I. C.	C. B. & Q.	A. T. & S. F.	N. Y. C.	Gt. Nor.	G. T. W.	U. S. R. A.	U. P.	C. of Ga.	U. S. R. A.	N. C. & St. L.	F. E. C.
Road class or number	T	L-1s	201	1401	M-50	MT-1	MT	B-1-A	3700	2700	P-2	U-1-C	Heavy	MT	1679	Light	J-1	427
Builder	R. R.	Amer.	Amer.	Amer.	Amer.	Amer.	L. & A.	Lima	Bald.	Amer.	Bald.	Bald.	A. & B.	Amer.	Amer.	A. & B.	Bald.	Amer.
Ordered or built	1925	1924	1923	1923	1923	1923	1924	1922	1924	1925	1923	1925	1918	1924	1923	1918	1925	1924
Tractive force, engine, lb	65,000	61,300	57,500	58,000	47,900	57,500	51,000	52,750	54,100	60,000	58,830	49,600	58,000	54,838	47,800	53,900	53,800	44,000
Tractive force, booster, lb	.....	.....	.....	.....	.....	10,100	.....	.....	.....	12,700	.....	.....	.....	.....	.....	.....	.....	.....
Cylinder horsepower (Cole)	3,406	3,182	2,965	2,824	2,683	2,965	2,824	2,755	2,824	2,953	3,030	2,556	2,824	3,030	2,493	2,624	2,624	2,434
Speed m.p.h. at 1,000 ft. piston speed	44.02	43.75	43.45	41.08	47.2	43.75	46.55	44.02	44.03	41.08	46.55	43.45	41.08	46.55	44.03	41.08	41.08	46.55
Weight of engine, lb	400,000	390,000	381,000	376,000	368,500	368,000	367,500	364,000	361,600	359,000	357,000	354,110	352,500	338,000	326,500	327,000	326,950	318,000
Weight on drivers, lb	275,000	261,500	262,000	257,500	252,500	246,000	247,000	245,000	246,300	240,500	238,000	231,370	243,000	224,000	214,500	224,500	217,970	214,000
Weight on front truck, lb	62,000	65,500	56,500	58,500	58,000	61,500	57,500	60,000	62,300	60,500	59,500	61,590	51,500	60,000	60,000	49,500	52,330	54,000
Weight on trailing truck, lb	63,000	63,300	62,500	60,000	58,000	60,500	63,000	59,000	53,000	58,000	59,500	61,150	57,500	54,000	52,000	53,000	56,650	50,000
Weight of tender, lb	259,300	251,000	201,600	217,300	196,000	224,000	205,300	205,800	242,900	275,000	235,000	250,490	195,500	247,800	187,300	192,000	192,050	255,900
Wheel base, driving, ft. and in	19—3	19—6	20—0	18—9	19—10	20—0	19—6	19—3	18—0	18—0	19—0	19—6	18—3	19—6	18—0	18—3	18—3	19—7
Wheel base, engine, ft. and in	41—4	43—7	42—2	41—0	42—1	42—3	42—3	41—7½	38—11	42—0	41—7	41—9	40—0	41—3	38—11	40—0	40—10	42—2
Wheel base, eng. and tender, ft. and in	89—0	83—4¼	81—9	77—2	79—1	83—6	77—8½	79—5	76—9⅝	84—7	80—0½	80—3¾	75—8½	79—11½	73—9½	75—8½	76—7	81—11⅝
Cylinders, diameter and stroke, in	30x30	29x30	28x30	28x30	28x28	28x30	26x28	27x30	28x28	27x30	29x28	26x30	28x30	29x28	27x28	27x30	27x30	26x28
Driving wheels, diameter, in	74	73½	73	69	74	73½	73	74	69	69	73	73	69	73	69	69	69	73
Steam pressure, lb	210	210	210	200	190	210	200	210	200	225	200	210	200	200	190	200	200	200
Fuel	Bit. coal	Bit. coal	Bit coal	Bit. coal	Bit. coal	Oil	Bit. coal	Lign.	Oil	Bit. coal	Oil	Bit. coal	Bit. coal	Oil	Bit. Coal	Bit. Coal	Bit. Coal	Oil
Boiler, diameter first ring, in	90	84½	82½	84¼	80	82⅞	82	78	82	82⅞	84	82⅞	86	82½	75	78	78	74⅝
Firebox, length, in	132¼	126⅛	120	120⅛	108⅛	120	120⅝	116⅞	122¼	120⅛	132	114⅛	114⅛	126	114⅛	120⅛	120⅛	114⅛
Firebox, width, in	96	96¼	90	96	84	90	90	96	84¼	90¼	96	84¼	96¼	96	84¼	84¼	84¼	84¼
Tubes, no. and diameter, in	269—2¼	234—2¼	223—2¼	285—2	216—2¼	223—2¼	220—2¼	198—2¼	254—2¼	219—3½	232—2¼	188—2¼	247—2¼	239—2¼	178—2¼	216—2¼	190—2¼	181—2¼
Flues, no. and diameter, in	48—5½	50—5½	45—5½	50—5⅜	45—5½	45—5½	45—5½	45—5½	43—5½	.....	50—5½	40—5½	45—5½	48—5½	36—5½	40—5½	45—5½	36—5½
Length over tube sheets, ft. and in	23—0	22—0	22—0	21—0	22—5	21—6	22—0	22—0	21—0	20—6	22—0	22—3	20—6	22—0	21—6	20—6	20—6	22—0
Grate area, sq. ft	89.17	84.3	75	80.4	63	75	75.4	77.9	71.7	75.3	88	66.7	76.3	84	66.8	70.3	71.1	66.8
Coal rate, lb. per sq. ft. grate per hr. (Cole)	124	123	128	114	138	127	122	115	128	127	112	125	120	117	121	117	120	119
Steam required per hr., lb. (Cole)	70,800	66,200	61,700	58,700	55,800	61,700	58,700	57,300	58,700	61,400	63,100	53,100	58,700	63,100	51,900	54,600	54,600	50,500
Heat. surface, firebox, total, sq. ft	383	459	388	389	394	350	442	381	359	356	400	307	373	345	329	348	408	340
Heat. surface, tubes and flues, sq. ft	5,208	4,599	4,297	4,590	4,283	4,202	4,258	3,976	4,425	4,095	4,571	3,731	4,293	4,598	3,354	3,773	3,608	3,472
Heat. surface, total evap., sq. ft	5,591	5,058	4,685	4,979	4,677	4,552	4,700	4,357	4,784	4,451	4,971	4,038	4,666	4,943	3,683	4,121	4,016	3,812
Superheating surface, sq. ft	1,305	1,390	1,190	1,292	1,247	1,162	1,227	1,100	1,092	1,985	1,368	1,048	1,085	1,331	961	966	1,145	944
Comb. evap. and super. surface, sq. ft	6,896	6,448	5,875	6,271	5,924	5,714	5,927	5,457	5,876	6,436	6,339	5,086	5,751	6,274	4,644	5,087	5,161	4,756
Tender, water capacity, gal	15,100	12,000	10,000	12,000	10,900	12,000	10,000	10,000	12,000	15,000	12,000	12,350	10,000	12,000	9,500	10,000	10,000	12,000
Tender, fuel capacity, tons or gal	18	18	16	14	16	4,000	18	20.8	4,000	18	5,000	18	16	5,200	15	16	16	5,000
Weight on drivers ÷ weight eng., per cent.	68.75	67.0	68.8	68.5	68.5	66.8	67.2	67.4	68.2	67.1	66.7	65.33	69.1	66.3	65.6	68.7	67.0	67.4
Weight on drivers ÷ tractive force	4.23	4.26	4.55	4.44	5.27	4.28	4.83	4.64	4.55	4.01	4.34	4.66	4.19	4.08	4.49	4.17	4.07	4.86
Weight of engine ÷ cylinder hp	117.4	122.5	128.5	133.0	137.3	124.0	130.0	132.2	128.0	121.5	117.8	138.5	124.5	111.5	131.0	124.5	124.5	130.6
Weight of engine ÷ comb. h. s	58.0	60.4	64.9	60.0	62.2	64.4	62.0	66.7	61.5	65.8	66.5	69.6	61.3	53.9	70.3	64.2	63.4	66.9
Comb. heat. surface ÷ cylinder hp	2.02	2.02	1.98	2.22	2.21	1.93	2.10	1.98	2.08	2.18	2.09	1.99	2.03	2.07	1.86	1.94	1.97	1.95
Tract. force ÷ comb. heating surface	9.44	9.51	9.80	9.26	8.08	10.07	8.60	9.68	9.21	9.32	9.65	9.76	10.08	8.74	10.28	10.59	10.43	9.26
Tract. force × dia. drivers ÷ comb. h. s	699	698	715	638	596	740	628	716	635	643	631	712	696	638	710	731	720	676
Cylinder hp. ÷ grate area	38.2	37.8	39.5	35.1	42.6	39.2	37.5	35.4	39.3	39.2	34.4	38.3	37.0	36.1	37.3	39.5	36.9	36.5
Comb. heat. surface ÷ grate area	77.4	76.5	78.4	78.0	94.0	76.2	78.6	70.1	81.9	85.5	72.1	76.2	75.4	74.7	69.6	72.4	72.6	71.2
Firebox surface ÷ grate area	4.30	5.45	5.17	4.84	6.25	4.63	5.86	4.89	5.01	4.73	4.55	4.61	4.90	4.11	4.93	4.95	5.74	5.09
Firebox surface, per cent evap. h. s	6.86	9.07	8.29	7.81	7.91	7.69	9.40	8.75	7.50	7.90	7.16	7.61	8.0	6.99	8.94	8.45	10.16	8.92
Superheat. surface, per cent evap. h. s	23.51	27.36	25.40	25.90	26.65	25.53	26.20	25.26	22.80	44.60	27.53	25.92	23.26	26.93	26.10	23.44	28.54	24.76
Notes	..	a-d-e	a	a	a-d	a-g	a-d	b	b	a-e-g-k	b	b-e	b	a	a-d-e	b	b-d	a-d

Key to notes: a—Boiler diam., inside; b—Boiler diam., outside; d—Syphon; e—Feedwater heater; g—Booster; k—Type E superheater.

Firing for smoke prevention and maximum efficiency*

By A. T. Mitchell,
Chief smoke inspector, Pittsburgh District, Pennsylvania Railroad

ALL Pennsylvania locomotives in shifting, work train and interchange freight service use low volatile coal exclusively in the Pittsburgh district. Each locomotive in passenger and freight service, working out of a Pittsburgh enginehouse, is supplied with 1,000 lb. of low volatile coal on the front of the tank to keep the fire in proper condition while lying at the enginehouse, to build the fire for the road and to aid in preventing smoke while the engine is in what is called the "smoke district." This low volatile coal is loaded after the fire has been cleaned or built, and the amount, 1,000 lb., has been found to be sufficient, although there is now under consideration the possibility of extending its use to local trains serving the suburban towns near Pittsburgh. Low volatile coal is used also in all power plants in the city whose boilers are fired by hand.

Engine house operation building fires

In the building of new fires at the enginehouses, two methods of lighting are used and two methods of furnishing draft.

In the first method the grates are covered with from six to eight inches of high volatile coal, on top of which is placed four to six inches of low volatile coal; a bag of wood shavings saturated with oil is spread over the coal and the house blower attached. The fire is then lighted, with the blower turned on sufficiently to keep down the smoke and to carry the fire over the entire firebox area—if the blower is turned on full at first, it is likely to carry some of the shavings out of the firebox. Air is admitted also through the fire door while the saturated shavings are burning. The amount of oil to be used, the regulation of the blower and the admission of air through the fire door are matter of judgment on the part of the operator; lighting off is therefore an operation requiring training and experience. As the coal ignites, the fire door is closed and the blower fully opened. The object in this method of building the fire "upside down" is to have all of the volatile matter, as it is distilled from the coal, pass through a zone of fire where it will be completely oxidized and not pass into the atmosphere as smoke. If the operations of building, lighting and supplying with air have been properly carried out, no more coal should be needed; however, in case it is necessary to supply an additional amount, low volatile coal only is used.

The second method of lighting fires is with the use of an oil burner, the oil being supplied under pressure and properly mixed with air before reaching the bed of solid fuel. The preparation in this method is the same as in the other; it is possible, however, with the use of the oil burner to raise steam in less time than with the first method. Here, also, training and experience are necessary, as there is possibility of injury to the firebox and flues if steam is advanced too rapidly in a cold boiler. Sufficient air is admitted to insure complete combustion, and the air pressure on the burner is sufficiently high to drive the flame through the coal. The house blower is used fully open and the fire lighted from front to rear of the firebox.

To furnish necessary draft, there are steam blower lines and fans. All enginehouses are equipped with steam blower lines, and in addition, those at the Scully and Pennsylvania avenue enginehouses have electrically driven fans, which are 10 ft. in diameter and are driven by 110-hp. motors at a speed of 240 rev. per min., furnishing a draft equivalent to 3½ in. of water at the base of the enginehouse stack, and 1½ in. at the point furthest from the stack.

From the base of the stack there is a duct extending around the enginehouse; between each pair of stalls there is an upright jack connected at one end with the duct and having two arms with hoods which fit over the stacks of locomotives. These jacks are equipped with dampers in order that the draft may be regulated at the locomotive. They are also equipped with periscopes so that if dense smoke shows at the top of the large stack, it will be possible to determine which locomotive is at fault. The steam blowers at Scully and Pennsylvania avenue enginehouses are used only in emergencies, which have been found rarely to occur; and as each of these enginehouses has two fans, it is planned to remove the steam lines entirely.

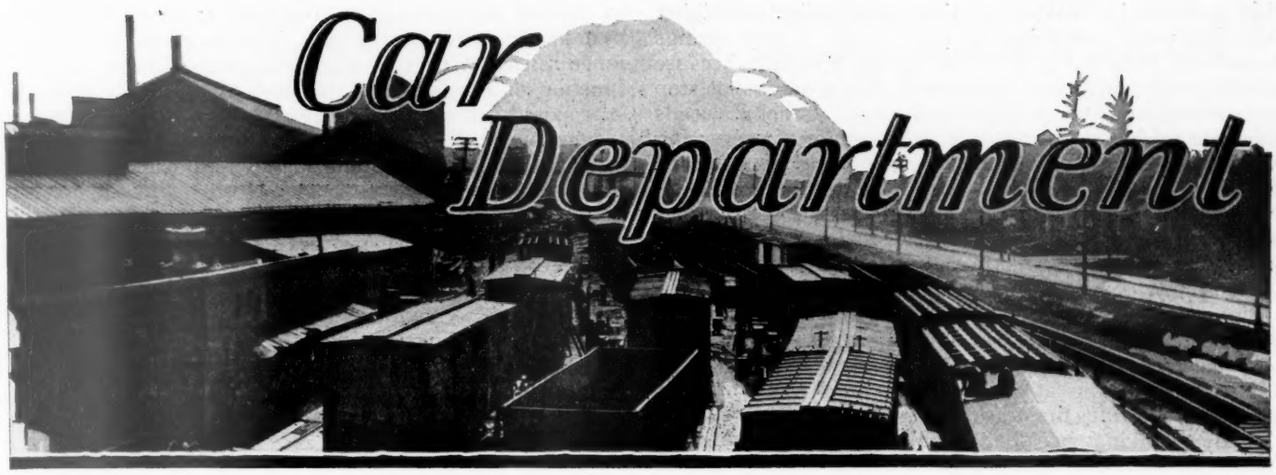
Cleaning fires

The work of cleaning fires begins on the road. A fireman is expected to bring his fire to the enginehouse without any green coal, and with enough live fire for cleaning. Any infraction of this rule is reported. There should be not less than 150 lb. of steam nor less than three scant gages of water. The engine, after being inspected, is placed over the ashpit. The method of cleaning then depends on the position of the drop grates. If there is a drop grate at the front and one at the rear, the fire is pulled back from the front of the firebox and the front grate dropped. After the front of the firebox is cleaned of ash and clinkers, the drop grate is put up and the grates covered with coal. Live fire is then pushed forward over the top of this coal, the back grate dropped and the rear of the firebox cleaned. Green coal is then placed on the grates and live fire pulled back over the top. Only low volatile coal is used after this time. An engine with one drop grate only is cleaned one side at a time, but under no circumstances should live fire be placed on the grates and green coal on top. The coal should be placed on the grates and the live fire on top, so that all volatile matter distilled will pass through a zone of fire. The blower should be regulated as necessary to prevent smoke.

Banking fires

After the fire is built and steam raised at the enginehouse, the engine is moved to the coal tipple and supplied with coal, including either a full supply or 1,000 lb. of low volatile coal, according to the service. It is taken then to the enginehouse or storage yard, where the fire is banked until the crew takes charge. In banking, one of two methods is used; if the engine is equipped with an arch, the fire is kept heaviest near the door. If there is no arch, the fire is heaviest against the flues. All fires are banked with low volatile coal, which is dampened before being put into the firebox. The coal is allowed to coke and the steam pressure is kept above 100 lbs. and three scant gages of water maintained, so that there will be sufficient fire in the firebox, that when the crew takes charge, it is necessary for the fireman only to open the blower slightly and advance the steam pressure, filling with low volatile coal any holes which may have burned in the fire. The engine is then ready to be taken to the station, where no firing is permitted except in case of emergency, and it is expected that the fire has been so prepared that the emergency will not occur.

*Abstracts from an address delivered at the annual convention of the Smoke Prevention Association held June 17-20, inclusive, at Grand Rapids, Michigan.



Causes and prevention of freight car derailments

Truck springs, car lading and truck design contributing factors which should be controlled by proper design

By T. H. Symington

President of The Symington Company, Baltimore, Md.

IN this article derailments occasioned by defective track will not be discussed; only those that in my opinion can be prevented by simple improvements in car design.

It is well known that in England track is laid square, that is, with the joint of one rail opposite the joint of the other rail. In this country track is laid diagonal, that is, the joint of one rail is opposite the middle of the opposite rail. On some railroads in this country it is proposed that the track be laid dissymmetrical, that is, with the rail joint on one side opposite a third or a fourth of the other rail length.

The reason for this suggestion is to break up the synchronization with the rail joints, on both sides of the track, of the pendulum roll of high capacity, high gravity cars. Freight cars, particularly high gravity cars, supported on coil springs which give out as much work as is put into them, roll from side to side with a pendulum action, and the timing of this roll is constant, regardless of the extent of the roll, which is a fundamental law of the pendulum. This roll synchronizes with the regular intervals of the diagonal rail joints at certain definite speeds, dependent on the design and lading of the car. When the pendulum swing of the car body coincides with the rail joints, so as to increase this roll, it becomes cumulative owing to the regular impulses caused by the slight depressions of the rail joints on both sides of the track, except where the track is in perfect surface.

With the track laid dissymmetrically, these evenly timed impulses causing an increase of the pendulum roll at the synchronizing speed for any car, would come from the rail joints on one side of the track only, and their frequency would, of course, be cut in half; but the opportunity for coincidence between the pendulum roll and the rail joints on one side or the other of the track, would be double. It is possible, however, that dissymmetrical rail joints would entirely break up the tendency to excessive rolling of the car body.

This cumulative roll from one side to the other results in the bolster springs going solid at times, and I venture to say that there is no high gravity 50-ton or 70-ton car in this country that has not, at some time, had its springs go solid under conditions favorable for the development of cumulative roll.

The part truck springs play in causing derailments

The A.R.A. standard 50-ton car spring is designed to go solid at 64,000 lb. and the 70-ton car spring at 80,000 lb., and it must be evident that these springs are often worked through a large range from practically no stress to a stress that will close them solid. This large working range of the truck spring results in its early failure through fatigue, or by its taking a permanent set which proportionately reduces its capacity. When the truck spring goes solid, there is always a localized bending moment somewhere in the coil, with an excessive resultant fibre stress, frequently causing the spring to break at this point. Truck springs on 50-ton and 70-ton freight cars are, therefore, giving general trouble.

The problem is difficult, because the height of the spring between the truck frame and the bolster is only 8½ in., which is a small space for a different design of spring, and the width of the window opening in the truck frame limits the designer in this direction. Also, the necessity for interchangeability with the A.R.A. standard increases the difficulty of the problem.

Some railroads that have had very large breakages of springs under 50-ton and 70-ton cars, are trying to solve

this problem by making a stiffer coil spring of higher capacity, with a resulting reduced travel. These springs apparently help the problem of spring breakage because of the lower fibre stress in the steel, but they do not stop the car roll so as to prevent derailments. Other railroads are approaching the problem from the angle of preventing derailments, and they seem to want a spring of increased travel over the standard. This design necessarily increases the fibre stress in the steel, when the spring goes solid, and we can expect a shorter life for this spring, if we cannot in some way stop excessive car rolling.

It is my opinion that the present A.R.A. standard spring would be satisfactory if its normal working range could be reduced. There is only one way of doing this, and that is to stop the rolling of the car body.

Excessive rolling at the present critical speeds can be stopped by laying the track in a dissymmetric manner, thereby breaking up the synchronization between the pendulum roll and the rail joints. All rolling can be stopped by developing a spring that has not a straight line action under compression and release, or in other words a spring that will absorb work and give out less energy than is applied to it.

The chart shown here illustrates the thought. Line *A-B* represents the compression and release curve of the A.R.A. 50-ton class D spring, and line *A-C* represents the compression and release curve of the 70-ton class H spring. Line *A-D* represents the compression and release curve of the higher capacity lesser travel spring that has been developed to minimize the breakage of springs on 50-ton cars, and *A-E* the curve for the same type of spring on 70-ton cars. Line *A-X* represents the compression and release curve of the longer travel spring for 50-ton cars and line *A-Y* the curve for the same type of spring for 70-ton cars.

What is needed, in my opinion, for a 50-ton car spring is a release line *B-F-A*, and for a 70-ton car spring a release line *C-G-A*, which would break up the roll of the car, regardless of the way the rails are laid.

In this connection it is well to realize that uncushioned shocks are most destructive, and result in broken axles, broken truck frames, broken and bent rails and the pounding of rail joints out of surface. It would certainly seem desirable to have, in addition to the suggested release curve for the 50-ton and 70-ton springs, a yielding peak of high capacity at the end of the travel of the standard 50-ton and 70-ton car springs, to take the uncushioned shock off the truck frames and track, in the event of these springs ever being fully compressed. The peak referred to is indicated by the line *H-J* for the 50-ton spring, and the line *K-L* for the 70-ton spring.

Referring to track conditions, it is well known that the superelevation of the outer rail on curves is a compromise. It is not high enough for high speed passenger service, and it is too high for slow speed freight service.

Relation of track conditions and car lading to derailments

It may not be generally known that when the high gravity, high capacity car is standing on a curve with a superelevation of 5 in. for the outer rail, there is 25 per cent more weight on the inner rail than normal, and 25 per cent less weight on the outer rail than normal. This unbalanced load condition on the rails will vary with the open top car and the stiff closed top car, when only one truck is on the curve.

Many flexible open top cars can be blocked up on their four corners, and then one corner can be jacked up as much as 14 in. before another corner will leave its blocking. This is not true of a stiff closed top car. Therefore, in the flexible open top car the lading can be considered as divided into three parts, one over each truck, and one part in the center of the car. The excess weight on the inner rail on a curve with the open top car is largely a function of the lading in one end of the car. With the stiff closed top car the excess of load on the inner rail is a function of the weight of the entire lading of the car.

In my opinion the rolling mass of the loaded car is the principal factor in derailments. If on a 5-in. superelevation curve the static excess weight on the inner rail is 25 per cent above normal, what must be the proportion of weight on the inner rail when the car body is rolling inward, due not only to the shifting of its center of gravity toward the inner rail, but due also to the momentum of this mass, particularly when the truck springs go solid

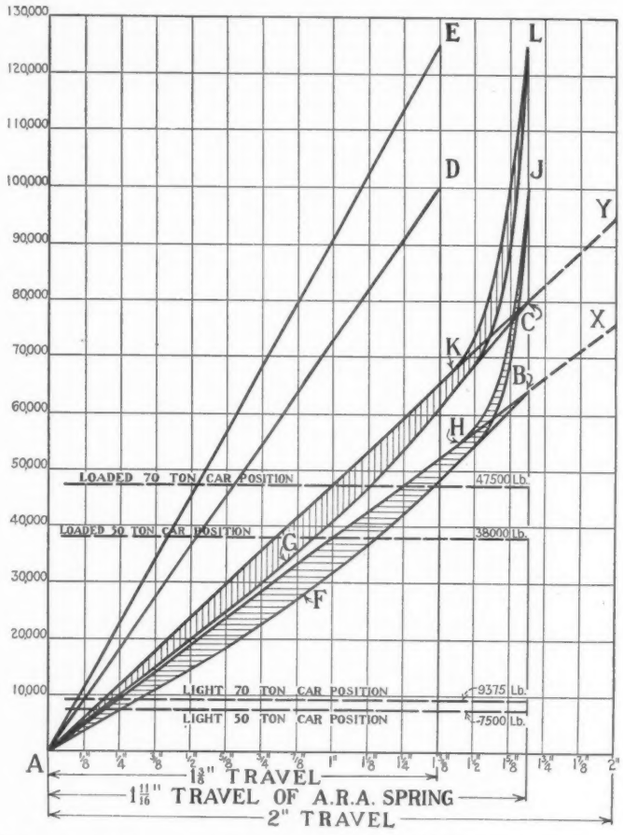


Chart showing the spring characteristics suggested for 50-ton and 70-ton cars

over the inner rail? This, of course, coincides with a corresponding reduction in weight on the outer rail.

There are no sudden high spots in railroad track. Defects in surface are all low spots, and one theory is that we need soft, long travel truck springs that will push the truck wheels down into the low spots. If this theory were entirely sound, cars running light without load would be more apt to leave the track, because under the light car the standard springs are very slightly compressed. That this theory does not fully explain the problem, is proved by the fact that far more loaded cars leave the track than light cars. I believe that some unloaded cars of special truck design have been derailed, because of forces not incident to the conventional four wheel truck.

In my opinion this is what happens in derailments. When the roll of the high gravity car synchronizes with the rail joints, the roll becomes excessive, and the pendulum swing increases to an amount that causes the car truck to fulcrum on the wheel treads on the inner rail,

and lift the outside forward wheel flange over the top of the outer rail.

Unfortunately when a car is on a curve the whole tendency of the wheels on the inner rail is to go ahead of the wheels on the outer rail, because the inner rail is shorter than the outer rail, resulting in the crowding of the outside front flange against the outside rail. Therefore, we have an ideal condition for derailment of the front outside wheel, because at the same instant the weight is taken off this wheel, it is forced against the rail so that it can easily climb over.

It must be evident, also, that when the car body has reached the limit of its swing towards the inner rail, the side bearings are in contact on the inside, and there is twice the normal side bearing clearance between the body and truck bolsters on the outside, so that the car body itself offers no resistance at the outer side bearing to prevent the outside wheels from lifting.

Freight car trucks should be rigid

It is unfortunate that the center and side bearing friction between the truck and body bolsters increases the tendency of the wheels on the outer rail to lag behind the wheels on the inner rail, when entering a curve, thereby increasing the pressure of the outer front flange against the rail, resulting in an increased tendency for this flange to climb over the rail.

There must be some slippage of wheels on a curve, with resulting friction, when any forces prevent the coning of the wheels from adjusting these wheels to their proper position on the rails, to avoid the slippage. The spring plank is the only means for holding the truck side frames square with each other so as to minimize this wheel and rail slippage friction. The spring plank resistance, consequently, must overcome both wheel and rail frictional slippage resistance, as well as center plate and side bearing frictional resistance. The total amount of these resistances has been established by test.

If the center plate and side bearing frictional resistance is minimized on a curve, the spring plank will hold the truck nearer square, and therefore reduce the pressure of the front wheel flange against the outside rail, and reduce the frictional resistance between this wheel flange and the rail. While the center plate and side bearing friction tend to hold the truck out of square on entering or while in a curve, this center plate and side bearing friction exert a force tending to square the truck when coming out of a curve, and it may be that we need some force of this character to help prevent the outside truck frame from continuing to lag behind the inside frame, when the car has come out of a curve on to a tangent.

Cars are held on the rails by the wheel flanges only, and these wheel flanges under the 50-ton and 70-ton cars of today have exactly the same height as the flanges under cars of 20 tons capacity 40 years ago. Furthermore, the track gage of 4 ft. 8½ in. under our big cars, is exactly the same as it was under the 20-ton cars.

It has been demonstrated that a rigid four wheel truck prevents the two inner wheels from going excessively ahead of the two outer wheels, resulting in less rail and wheel flange friction; but it is not possible to make our modern freight car trucks absolutely rigid in this respect. The A.R.A. truck is comparatively rigid because of the bossing of each side frame into the spring plank at four points. With a swiveling spring plank, the inner side frame is prevented from going excessively ahead of the outer frame by the unmechanical cramping of the truck bolster in the side frames, or by the unmechanical cramping of the axle ends in the journal boxes, dependent on the local clearances in each individual truck. Under these conditions, there is either rapid wear of the bolster and side frame pedestal ways, rapid wear with heating of journals and brasses, or both.

Suggestions to prevent car derailments

We cannot today change our wheel flanges, the gage of our track, the longitudinal flexibility of our trucks, or the large inertia forces incident to our high capacity, high gravity cars. We cannot lay our rails in a dissymmetric manner to break up synchronization without prohibitive expense. We, therefore, are confined to what we can do with the cars themselves. In my opinion we can prevent derailments by lowering the center of gravity on new cars, and by designing the springs and car suspension to control the forces causing derailments.

If a car rolls sufficiently to lift the wheels on a straight track, derailments rarely occur, because the wheels normally drop back into their proper positions, with the flanges on the inside of the rails. Therefore our study will be confined to the conditions on a curve. If we prevent a car from rolling on entering or leaving a curve, we will, of course, prevent its rolling on straight track.

1—The first and most obvious improvement for high gravity cars is to put a spring of elliptic work-absorbing action under freight cars, with a curve of compression and release somewhat similar to lines *A-B-F-A*, or *A-C-G-A* shown in the chart. Of course this spring must be interchangeable with the present A.R.A. standard spring, and its fibre stress must be low enough to insure a reasonably long life for the spring.

2—As far as possible we should minimize center plate and side bearing friction, to prevent excessive pressure of the front outside wheel flange against the rail, which causes derailments, excessive wheel flange and rail wear, and also increases train resistance.

3—We should construct the four wheel trucks as rigid as is practical in the connection between the side frames and the spring plank.

4—We should arrange the spring suspension so that some load is always maintained on the outside wheels, regardless of whether the outside springs are broken, or have taken a permanent set.

It is not practicable to maintain all track in surface and alinement, similar to first class main line track. Therefore, our problem is to design freight car trucks so that they will stay on a track that is reasonably out of surface and alinement.

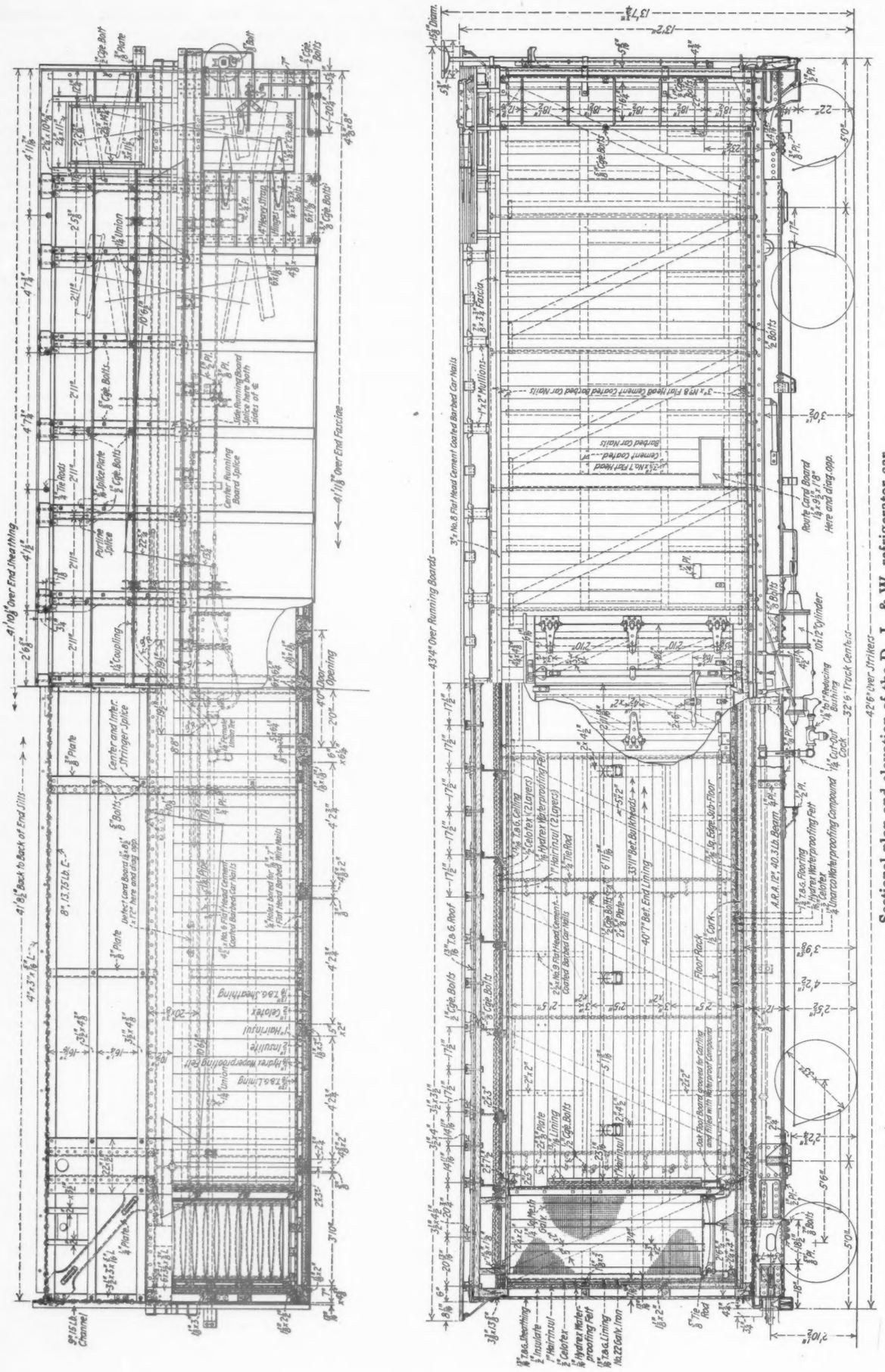
The vertical jiggle of coil springs is largely responsible for coupler and knuckle wear, bolster and side frame pedestal wear, and the tendency of cars to uncouple in fast freight service. The vertical jiggle of coil springs and the excessive roll of the car body are largely responsible for damage to box and refrigerator car roofs.

A freer radial action will not only help prevent derailments, but will minimize rail and wheel flange wear. It has been demonstrated to reduce train resistance on curved track.

A cushioned blow, when the truck spring goes solid, will largely prevent side frame, axle and rail breakages, and make it easier to maintain track in proper surface.

A smooth running freight car, without roll, with no uncushioned shocks, and with free radial action of the trucks, will simplify and reduce the cost of maintenance of all track. The required strength of rails, wheels, axles, side frames, bolsters and car framing, has been developed empirically in service, under excessive shocks, that can be largely reduced, and it is possible that the future freight car can be materially lightened.

It is my opinion that all open top and stiff closed top freight cars can be so equipped in their trucks that they can be operated with safety over the roughest track.



Sectional plan and elevation of the D., L. & W. refrigerator car

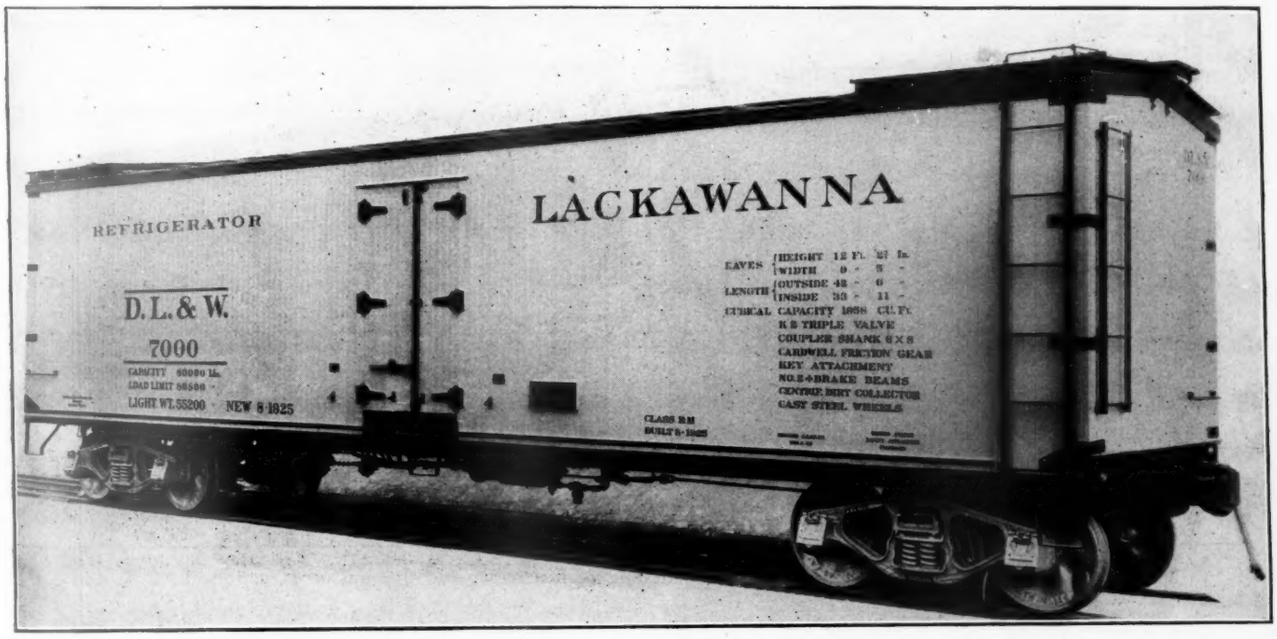
Fruit refrigerator cars for D. L. & W.

Insulated and ventilated to afford protection in cold and hot weather—A. R. A. standards closely followed

By P. Alquist

Master car builder, D. L. & W., Scranton, Pa.

A SHORT time ago the Delaware, Lackawanna & Western received 300 refrigerator cars which represent the latest improvements and A.R.A. standards. These cars were built by the American Car & Foundry Company, at its Berwick, Pa., plant. They are 42 ft. 6 in. long and weigh 55,200 lb.; stenciled capacity, 80,000 lb. These cars were designed for the most difficult requirements of fruit transportation. Bananas are now being received at the Port of New York in a fleet of well insulated vessels. The railroads are called on to transport this fruit during the summer and winter months to distant inland cities in refrigerator cars without the use of stoves en route, maintaining a temperature during the winter months between 55 and 66 deg. F., as bananas will chill below this minimum. This is accomplished by preheating the cars at the ship side by the use of stoves which are removed after the cars are loaded. The condition in which fruit arrives at its destination depends on the construction and insulation of the car, as well as the tight fit of ice hatches and side doors.



Lackawanna refrigerator car which weighs 55,200 lb. and has a capacity of 80,000 lb.

During the summer months maximum ventilation is required in order to remove the heat generated by the fruit and to retard ripening. This is accomplished by direct ventilation with maximum air space through the ice hatches and bunkers, eliminating the usual splash board and using high floor racks. In extreme warm weather, long distance shipments require light icing. The cars have hinged floor racks, and sections fold back at the doorway and near the ice bunkers to permit the loading of merchandise on the return movement, if not needed for perishable commodities requiring icing.

The cars are provided with steel underframes consisting of two standard A.R.A. center sills of 12-in. special rolled channels, weighing 40.3 lb. per foot. These are held together by a ⅜-in. by 20-in. cover plate. The side sills are composed of 8-in. shipbuilding channels, weighing 17.6 lb. per foot, with a 3-in. by 4-in. by 5/16-in. angles riveted to the outside to receive the wood side sills to which the side frame of the car is secured. The end sills are made of 9-in. channels weighing 15 lb. per foot, reinforced on the back with 3-in. by 3½-in. by 5/16-in. angles to receive the wooden floor stringers. The body bolsters are of the built-up type with cast steel center fillers. The needle beams are of the built-up type with the top and bottom cover plates ½ in. by 12 in., riveted to the center sill channels and two 5/16-in. pressed steel fillers placed between them with the ends riveted to the side and center sill channels. A 3-in. by 3-in. by ¼-in. angle is riveted to the web of the pressed steel fillers and under the side of the top cover plate.

Each corner of the underframe is reinforced by a 4-in., 8.2 lb. Z-bar diagonal brace. There are also six pressed steel pans ⅜ in. thick, extending from the center sills to the side sill channels, spaced between the needle beams and the body bolster and at the center of the car for additional supports to the wooden floor stringers.

The trucks are of the Bettendorf "U" section type, provided with the Barber lateral motion device. Cast

steel truck bolsters are used. Davis cast steel wheels, Creco four-point brake beams and Schafer pressed steel "U" type bottom connections with self-locking hangers are used. All the brake pins are fastened with positive brake pin locks.

Body construction

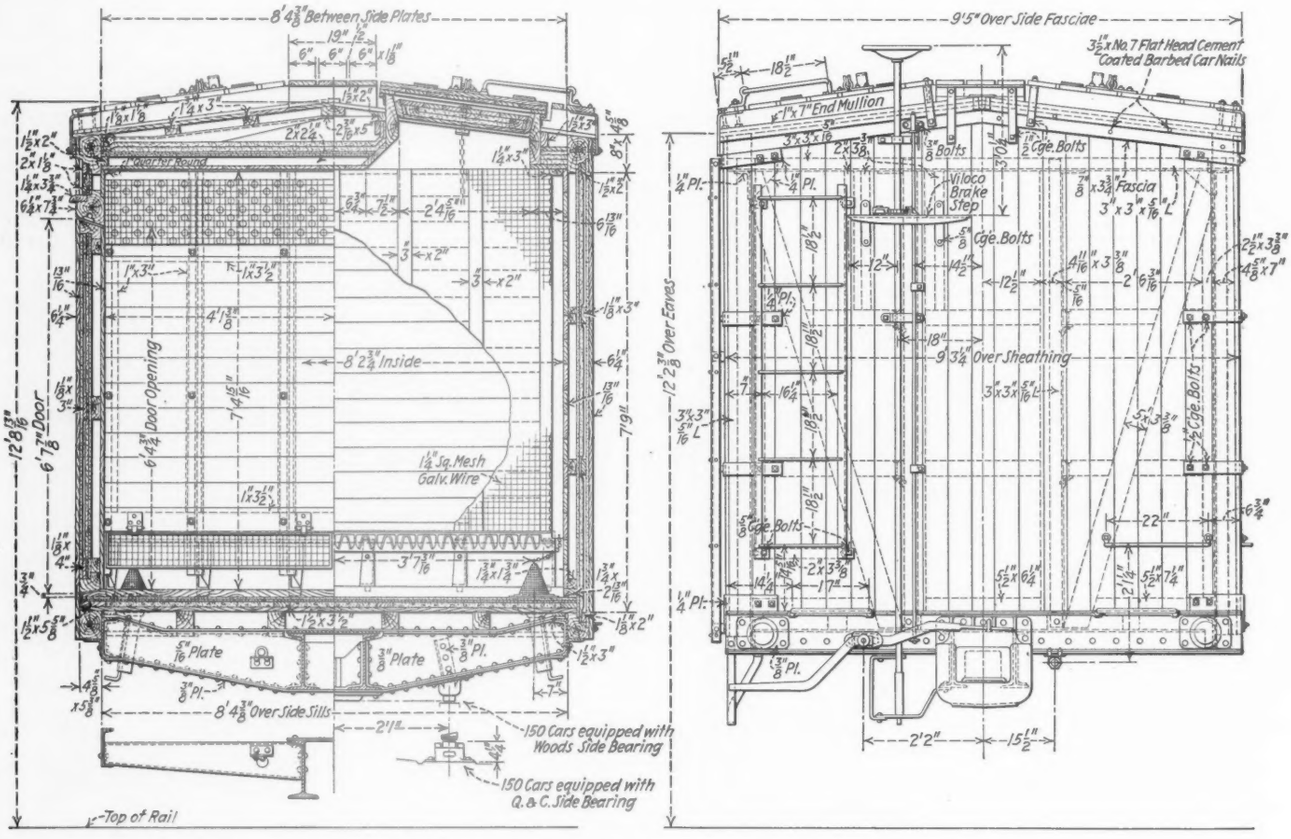
Practically the entire superstructure is built of Douglas fir. The wood side stringers extend from end sill to end sill and are securely bolted with horizontal and vertical bolts to the metal side sills which are attached to the side framing of the car. There are two center and two intermediate floor stringers.

The lower course of flooring consists of 13/16-in. by 5¼-in. rain-tight boards laid in white lead and secured on top of the four intermediate longitudinal stringers and the two side stringers with eight-penny, cement coated, heavy barbed car nails. On top of this is placed a layer

The door posts are of 6-in. by 6¼-in. white oak with the ends fitted into cast steel top and bottom post pockets. The side doors are equipped with Miner refrigerator door fasteners and LaFlare insulation. Automatic open door fasteners of the L. & N. type are used. After the canvas insulation on the doors had been applied, it was coated with equal parts of paraffin and tallow which was applied while hot.

Ice boxes

Equipco all-metal pilferage roof, bulkheads and ice grates, with a specially large opening over the insulated bulkhead are used to insure maximum ventilation. There are four Equipco pressed steel well traps with agitators, one located near each corner of the car and securely riveted and soldered water-tight to the drip pans under the ice box. The drip pans are of No. 14 galvanized iron and extend 6½ in. up and over the special bunker floor boards.


8'4 3/8" Between Side Plates
19" Door
6" 6" 6" x 1/8"
Door Opening
8'2 3/4" Inside
1/4" Sq. Mesh Galv. Wire
5/16" Plate
3/8" Plate
8'4 3/8" Over Side Sills
150 Cars equipped with Woods Side Bearing
150 Cars equipped with Q. & C. Side Bearing
Top of Rail
9'5" Over Side Fascias
3 1/2" x No. 7 Flat Head Cement Coated Barbed Car Nails
1" x 7" End Mullion
3/8" Bolts
1/2" Cge. Bolts
Viloco Brake Step
7/8" x 3 3/4" Fascia
5/8" Cge. Bolts
18" - 9 3/4" Over Sheathing
12' 2 3/8" Over Eaves
22"

Cross-section of the car showing the method of insulating and the end construction

of Hydrex water proofing felt. Upon this felt is then laid a course of ½-in. Celotex. Over the Celotex is laid 1½ in. of non-void insulation between 1½-in. by 3½-in. nailing strips. This entire surface is then covered with a ¼-in. coat of Unarco weather-proof coating. The upper or main floor is laid of kiln dried decking, 1¾ in. thick by 5¼ in. wide. The edges of the floor are filled in with a weather-proofing compound. The frame work of the roof consists of 13 pressed steel Z-bar and U-section carlines of 3/16-in. material. These are securely bolted to the ridge-pole which is dressed to 2 3/16 in. by 5 in. and shaped on top to conform to the angles of the roof. The fascia boards are 7⅛ in. by 3¼ in. wide with the lower edge formed as shown in the illustration. A No. 22-gage outside flexible metal roof, manufactured by the Standard Equipment Company, is used.

The vertical flanges of the floorpan are back of the No. 22 galvanized iron with which the side and end linings of the ice boxes are covered from the floor to the plates. Each well trap is provided with a scum can made of galvanized iron, wire screened and secured to the frame of the ice tank with a galvanized iron chain.

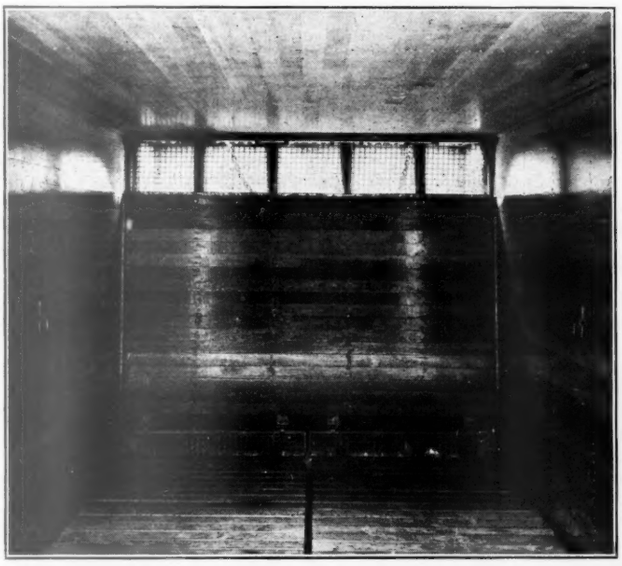
Each bulkhead is lined with Douglas fir, with two courses of ½-in. Keystone hairfelt with 80-lb. paper stitched on both sides. One layer of Hydrex weather-proofing felt is applied on each side of the hairfelt and secured with nailing strips. The opening under the bulkheads is provided with swinging protection screens of 1-in. No. 6-gage galvanized wire screen which is properly framed and applied to the bulkhead to prevent the lading from shifting into the ice pans.

The four hatch framings consist of Douglas fir. The

hatch frame covers and plugs are of the U. S. R. A. type, but with the plug detached in order to obtain full opening when required.

Insulation of the roof, side and end walls of the refrigerator cars

A sub-ceiling of 3/8-in. by 3¼-in. Douglas fir is nailed to the 2-in. by 3-in. cross nailers. Over this, the insulation material consists of one course of Hydrex water-proofing felt, on which is then laid two layers of ½-in. Flaxlinum insulation, over which is laid three layers of ½-in. Keystone hairfelt with 80-lb. paper stitched on both sides in one piece from side plate to side plate and from the wooden carlines at each ice tank furring. All of the above insulation is held in place at the intermediate steel carlines by bolts passing through the ceiling nailing strips and the bottom flange of the steel carlines. The insulation between the hatches under the carlines and plates is of the same material as specified above and is turned up at the sides and ends and secured to the car by insulation strips.



Equipco all metal pilferage proof bulkhead and ice grates with a special enlarged opening to insure maximum ventilation

The insulating material in the side and end walls consists, first, of one continuous layer of Hydrex weather-proofing felt which covers the main posts and braces from the door post to the corner post and runs from the side sill to the side plate, together with two courses of ½-in. Flaxinum. The next insulating material consists of one continuous layer of ½-in. Keystone hairfelt with 80-lb. paper stitched on both sides, which is securely held in place by insulation strips. On these strips is placed one continuous piece of Hydrex water-proofing felt, after which 13/16-in. Douglas fir side sheathing is applied. The end walls are substantially the same except that 2-in. non-void cork is used.

A.R.A. Type "D" couplers with a 6-in. by 8-in. shank with Universal yokes, cast steel draft lugs and Cardwell friction draft gear type G-111-AA are used. The air brake equipment consists of Westinghouse air brake schedule KC-1012, K-2 triple valves, double-spring retainers with Universal booster in the hand brake to give 3,950 lb. at the brake cylinder push rod connection to the cylinder lever. Wine Railway Appliance Company safety first ladders with Viloco step treads were used.

The following are the general dimensions of these cars:

Length over buffers	42 ft.	6	in.
Length over end sheathing	41 ft.	10⅛	in.
Length over end framing	41 ft.	8½	in.
Length inside of lining between ice boxes	33 ft.	11	in.
Width over eaves	9 ft.	5	in.
Width over side sheathing	7 ft.	3¼	in.
Width over side sills	7 ft.	1⅝	in.
Width inside of lining	8 ft.	2¼	in.
Width of door opening	4 ft.	0	in.
Height of door opening	6 ft.	4¾	in.
Height from rail to eaves	12 ft.	2⅝	in.
Height from coil over all	13 ft.	7¾	in.
Height from top of floor to the ceiling	7 ft.	5¼	in.
Cubic feet capacity	1,958		

Adjustable scaffolding for car shops

FROM a labor saving standpoint, it is essential that every passenger and car repair shop should be provided with a form of adjustable scaffolding. Such scaffoldings can be generally made in the shop which was the case of the equipment shown in the illustration and used in the passenger car repair shops of the Delaware, Lackawanna & Western at Kingsland, N. J.

The framework of the scaffolding consists of 4-in. I-beams properly spaced to meet existing conditions. The beams are breeched by two parallel angle irons. Holes ½-in. in diameter, 9-in. apart, are drilled the length of the flange facing the repair track. The brackets which hold the boards are fitted over this flange by three clamps which slide along the I-beam. A chain, 12-in. long, at the end of which is attached a pin which fits in the holes, is attached to each bracket. Located at the center of the underside of each board is a box which contains scrap metal, the purpose of which is to counterbalance the board, with the counterbalance supported by a ¼-in. cable which passes over a 6-in. pulley located at the top of each I-beam. Each box is carefully weighted so that the board can readily be raised or lowered by one man. Each box is supported by a 5/8-in. truss rod which passes between the two brackets.

A rigidly constructed scaffolding which can be easily moved by hand to various heights

This scaffolding is cheap to construct, will withstand hard usage and is easy to operate. Furthermore, the frame work can be used to advantage for locating power outlets. It will be noted from the illustration that there is an outlet at the middle of the lower angle iron of each pair of I-beams. These outlets are used for attaching electric lights and motors.

Japanese railways adopt automatic couplers

Final work of changing from the screw and link type to the automatic is completed in one day

By S. Akiyama

Director, Mechanical Engineering Bureau, Japanese Government Railways, Tokyo, Japan

SHORTLY after the nationalization of the Japanese railways in 1906, it was decided that steps should be taken to equip the rolling stock with automatic couplers. At that time, with the exception of the Sapporo division in Hokkaido, which had adopted an automatic coupler of an American type more than 15 years ago, all of the Japanese railways were using the screw and link type. The preparatory work of changing the couplers on all of the rolling stock was begun in 1918 and this work was completed in the spring of 1925. This preparatory work consisted essentially of altering the center and end sills on all old equipment and seeing that the design of all new equipment was such as to permit the application of the automatic coupler and draft gear at the appointed time.

Table I—Number of freight cars and workmen assigned to each coupler changing station

Division		Tokyo	Nagoya	Kobe	Moji: Sanyo District	Moji: Kyushu District	Sendai	Total
Pre-determined allotment of cars		15,000	10,000	10,000	2,500	8,650	6,500	52,650
Pre-determined allotment for July 17 and 20		12,700	8,300	7,849	1,850	7,162	4,800	42,637
Actual number of freight cars on which the couplers were changed on July 20		12,517	8,380	7,607	1,842	7,123	4,213	41,682
Number of workmen employed on July 17 or 20.	Repair shops	2,937	2,138	1,507	452	1,492	1,024	9,540
	Car inspecting points	735	272	698	40	300	354	2,419
	Total	3,682	2,410	2,205	492	1,792	1,378	11,959
Number of cars per workman		3.45	3.44	3.35	3.76	3.99	3.48	3.56
Number of coupler changing stations		50	54	39	8	45	25	221

The most important factor in the making of this change was to see that traffic went on with as few interruptions as possible. It was decided to perform the work of making the final change of couplers during the month of July. In Japan, the month of July is quite hot and, furthermore, the freight traffic is comparatively light. Many of the freight cars are withdrawn from service, and it was possible to apply the automatic couplers on these cars at any convenient time. The committee in charge of planning the work also took into consideration the fact that the days are quite long in July, so it was finally decided that the final work of changing the couplers should be done on July 17.

July 15 and 16 being Buddhist holidays, it was estimated that the freight traffic would be especially light on July 17. This schedule applied to all districts except the Kyushu district, where the final change was made on July 20. Table I shows the number of locomotives and passenger cars on which the couplers were changed divided according to districts and Table II shows the total number of freight cars and workmen assigned to the various coupler-changing stations.

Planning and organization of the work

All of the plans for the preparatory work were made by the Mechanical Department of the Railway Ministry and the work was performed at the various railway shops. The final change-work was planned by a committee presided over by the vice-minister, but this committee drew up only a general plan. Detailed plans were submitted by a committee nominated by each division office. Each division committee consisted of the chief of the operation section, who served as chairman. Both the chiefs of the mechanical section and the chief of the transportation section served as vice-chairmen and a number of shop managers, car distributing agents, etc., served as engineers and secretaries. Upon the receipt of each detailed plan, it was necessary to decide what factors were common to all divisions and to solve this problem an executive committee was nominated from the committee in the ministry. This committee was presided over by the chief of the operation section and it met with the divisional committees at which time all necessary arrangements were worked out.

The organization of the executive forces for carrying out the work was not identical on all of the divisions. The organization on the Tokyo division, however, is typical. The headquarters of the Tokyo division was located in the division office. On this division ten district headquarters were established, the chief of each being either the district traffic officer or works manager. There were 19 local headquarters under the control of the district headquarters, the chiefs of which were usually the leading engineers of the repair shops. There were 54 working organizations, the chief of each usually being an assistant engineer at a repair shop. There were 50 changing stations. One crew was assigned to each changing station and two crews each were assigned to four of the

Table II—Showing the number of passenger cars and locomotives on which the couplers were changed

Passenger cars changed on July 16 and 17:

	Both ends	One end
Tokyo	90	504
Nagoya	51	353
Kobe	76	432
Moji	25	109
Sendai	40	345

Kyushu district—total passenger cars, 1,046.
Honshu district—total passenger cars, 7,327.

Passenger cars changed on July 19 and 20:

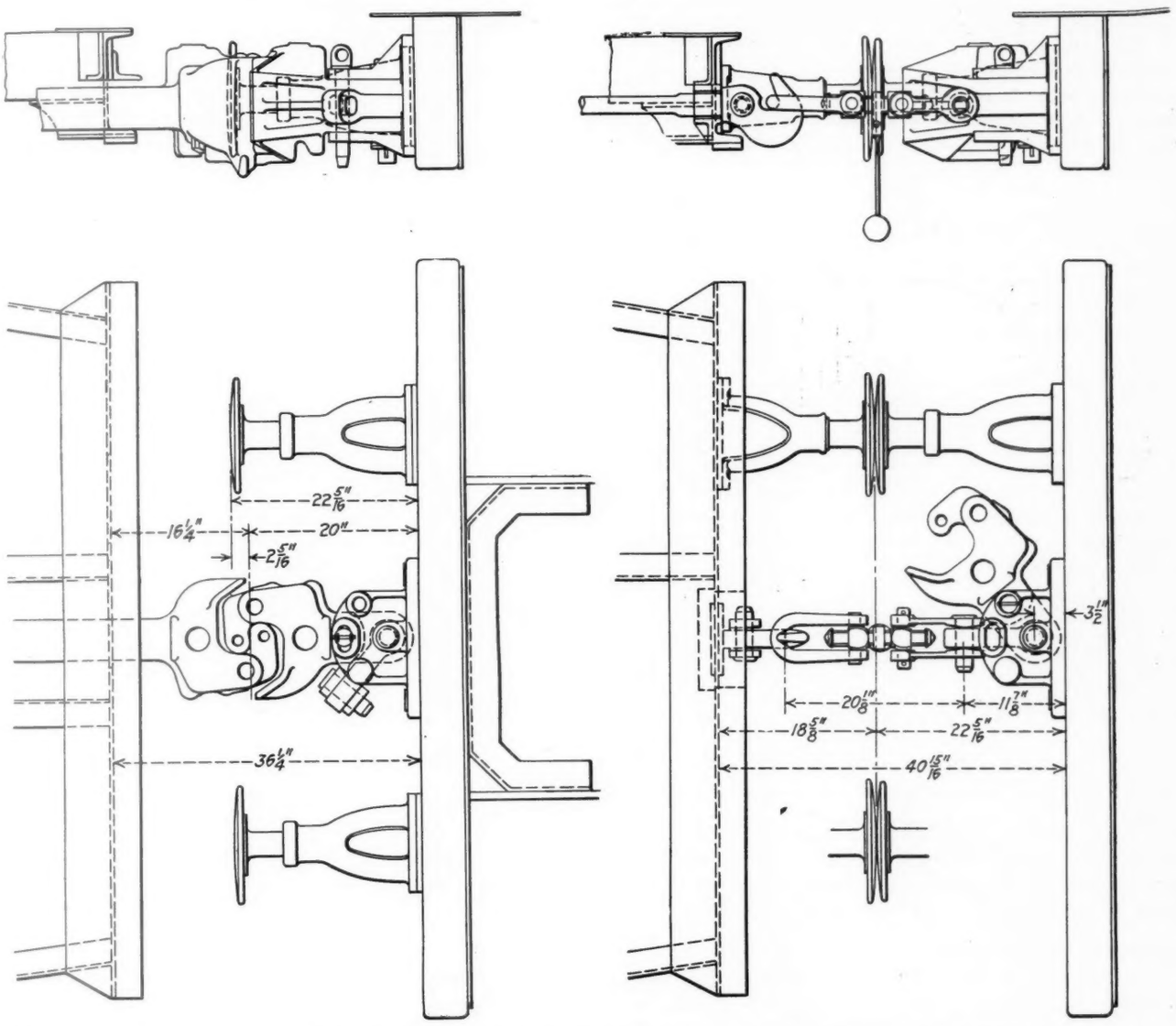
Both ends	One end
42	315

All districts—total locomotives, 3,094.

larger changing stations. Each crew was divided into parties in charge of a foreman and each party was divided into gangs, consisting of from five to eight workmen as required. Nineteen gas cutting gangs and 11 relief gangs were distributed among the various local headquarters. There were also 50 "settling" gangs under the jurisdiction of the local headquarters, one of which was assigned to each changing station. A station master was placed in charge of each of these gangs. The function of these gangs was to arrange the cars as required by the working crew, to prepare lodgings and meals, and to dispose of the old couplers, buffers, etc. The "settling" gang consisted of yardmen and employees other than shopmen. This system of organization as outlined, proved to be quite satisfactory.

In planning the details of the organization just described, it was deemed advisable to make several tests. In one of these tests, two skilled workmen changed the couplers of 10 cars in nine working hours. In another test, two workman who had only one or two months' experience as workers in a freight car repair shop and had only practiced changing couplers three times, succeeded in changing the couplers of six cars in nine working hours. After repeated tests at several shops and car inspection points, we came to the conclusion that as a fair average we could counts on about 3½ freight cars per workman, assuming that all classes of workmen employed in the shops were to be used in making the change of couplers.

Workmen of all classes were started about one year ago in a series of training exercises. This work was taken up at all of the shops and car inspection points. It was first done on a rather small scale but as the time for the change approached, the training was performed more intensively so that eventually each workman had at least one day's practice. Some of the workers at the car inspection points were trained to make the change on the freight cars and the remainder were trained to make the change on passenger cars. The work of changing the couplers on the locomotives was performed by the locomotive shop repair men.



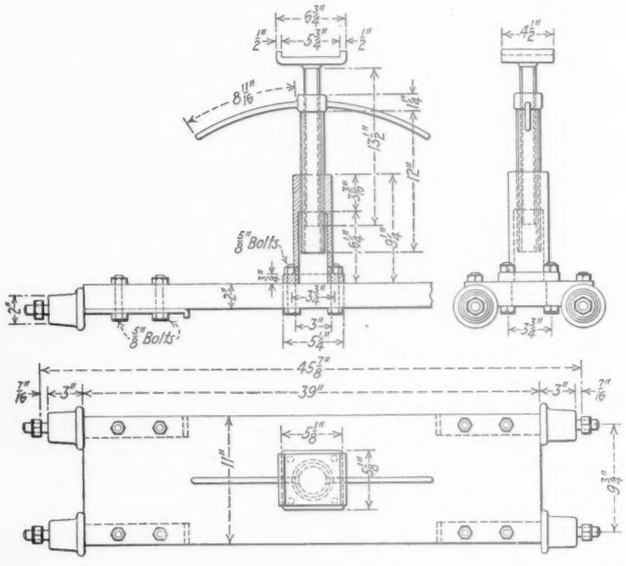
Special coupler designed for switching locomotives handling cars equipped with either automatic or screw and link types

The preparatory work was performed in three stages

The preparatory work was performed in three stages; the first stage consisting of the reconstruction of both ends of the underframe, a portion of the center sills and the attaching of a pair of follower guides to the inside of

the center sills. About one-third of the freight cars were equipped with wooden center sills. These were not strong enough to be used with the automatic coupler and for this reason they were strengthened by means of flat bars, tie rods or angle bars. The center of the end sill was cut to make room for the shank of the automatic coupler, and angle bars were secured above and below to serve as guides for the coupler shank. After the first stage of the preparatory work was completed, the old style drawbar used with the screw and link couplers, was arranged with a special washer to receive the drawbar spring. This reconstruction was performed on all of the passenger and freight cars. The first stage of perparatory work on the tenders was the same as that used on the freight cars.

The second stage of the preparatory work consisted of temporarily hanging the coupler with the draft gear crosswise under the center sills as shown in one of the drawings. The uncoupling lever was also attached. This work was done only on freight cars. There were, however,

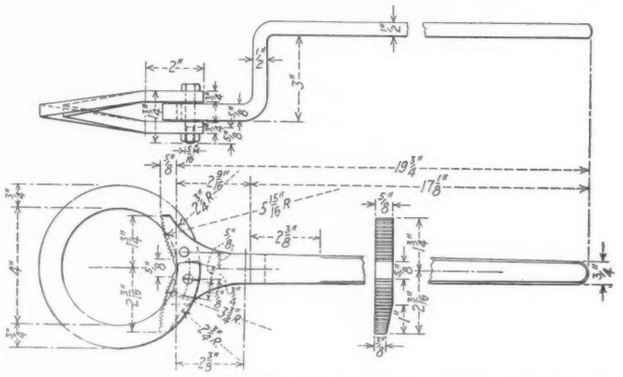


Jack used in the final application of the automatic couplers and draft gears

several kinds of freight cars whose construction did not permit this to be done. Such cars were treated as special cars and other arrangements were made so that the change of couplers could be made on July 17. The couplers were changed on the locomotives and passenger cars as they were brought into the shops for repairs. With this system, the number of locomotives and passenger cars of which the couplers had to be changed at a certain terminal, was known and all the material required was allotted in exact quantities.

The third stage of the preparatory work was the testing of the first stage. It was essential that we knew whether or not the reconstruction of the cars had been properly performed so that the change of couplers could be effected without any trouble. Special gages were provided for making this test. The test consisted of taking the coupler and draft gear which was hung under the center sills and applying them to the underframe as it was to be done on July 17. The uncoupling lever was also examined. The coupler was then taken out and again hung under the center sills. The side buffers were also taken off and attached again. All bolts and nuts were lubricated to prevent their becoming rusty.

This third stage of the preparatory work proved quite



Spanner wrench for unscrewing the nuts of the rigging that held the drawbar to the center sills

effective, not only in discovering defective work, but also in familiarizing the employees with the operations to be performed on July 17.

Special tools and equipment were required to complete the work

The tools and appliances used in completing the third stage of the preparatory work were the same as those used in the regular routine work of changing the couplers. The majority of these tools were not of standard design, being devised by a number of men and, of course, were not uniform throughout all divisions. There were, however, two devices, namely, the jack for the coupler and the spanner for the drawbar nut which were standard. These two devices, which are shown in two of the drawings, were the results of a design obtained by a competition and were extensively used. The jack is a double threaded, double screw jack. The minimum height is 15¾ in., so that it can be placed to receive the coupler which is held under the center sills of the car. The maximum height is 32½ in., which is sufficient to jack the coupler up to its proper position between the draft sills. The spanner, shown in Fig. 3, was designed to unscrew the nuts which held the coupler when hung under the center sills. Both of these tools are of light construction, easy to handle and cheaply made because they were intended for temporary use only.

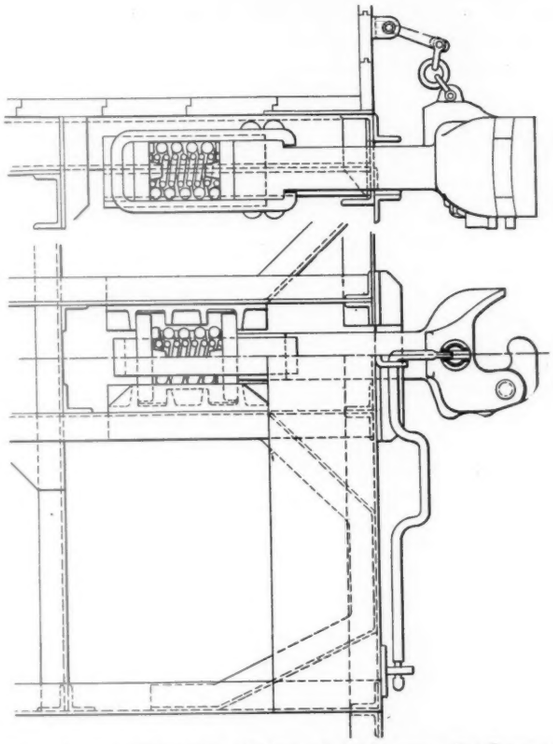
Changing the couplers on the passenger cars

The plans made by the Mechanical Department of the Railway Ministry required that the coupler-change on all

Total expense of changing the couplers

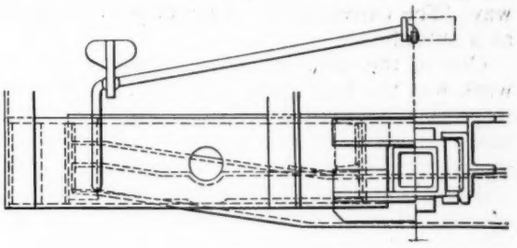
	Locomotives		Passenger cars		Freight cars		
	No.	Expense	No.	Expense	No.	Expense	Total
Preparatory work of first stage	2,529	$328,500	6,385	$1,304,000	41,667	$4,925,000	$6,557,500
Materials, including couplers, their erection	3,344	345,500	9,057	782,300	51,541	4,122,000	5,249,800
Preparatory work of second stage	.....	.....	.....	.....	.....	291,500	291,500
Total cost of changing couplers	.....	.....	.....	.....	.....	.....	$12,098,800

the freight cars be made on July 17 in order to avoid interfering with the movement of traffic as little as possible. The changing of the couplers on the passenger cars, however, could not be done at one time because the cars making up a train were usually treated as one set and were seldom used in other trains. Thus, the couplers on the passenger cars which composed a regular train were changed in the period between July 1 and July 10, except the couplers on either end of the train. The couplers on spare cars and those undergoing repairs were changed during the period between July 11 and July 16. The couplers on either end of the train and the locomotive couplers were changed on July 16 and 17. This arrangement was carried out in all districts except in the Kyushu district where these couplers were changed on July 19 and 20.



Drawing showing the design of draft gear the Japanese Government Railways are using in connection with the automobile coupler

The changing of the couplers on the end cars of the train and the locomotive, was done according to a predetermined schedule arranged to conform to the short time that the locomotive and train were to stay in the terminal, between trips. With this arrangement, the passenger service on July 16 and 17 was maintained with its usual regularity. It was necessary to provide a switching locomotive with a special coupling to handle cars equipped with either type of coupler.

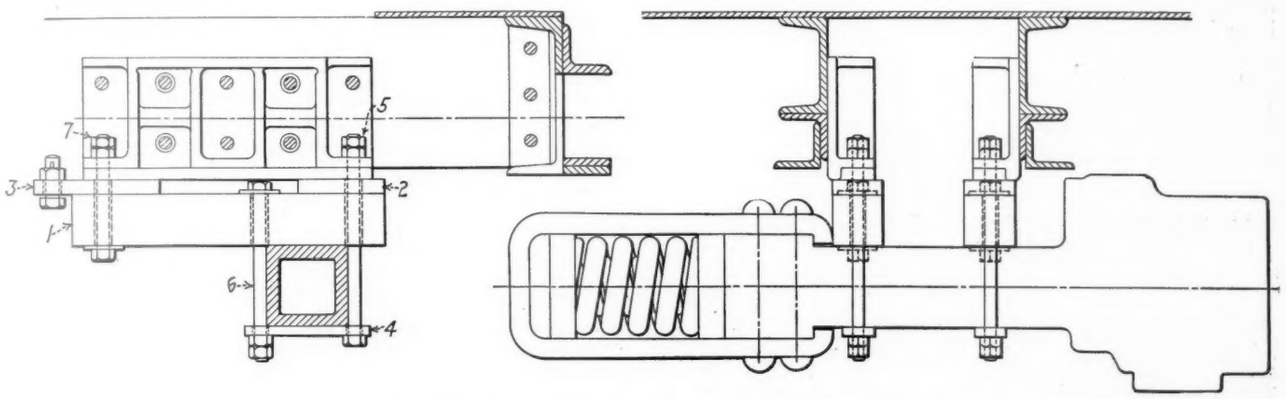


Freight train service was suspended for one day

Freight train service was suspended for one entire day; namely, from midnight to midnight, except for certain special freight trains used for the transportation of fish, etc. In some districts the number of delayed trains was comparatively large, and at points where the station yards were comparatively large, it was found that the change-work could be performed by suspending only a few freight trains. It would have been poor practice to have adopted such a system on the main lines because a delay in any station would have caused confusion on the whole system and even the passenger service might have become seriously affected. For this reason, after the suspension of the regular freight trains, all of the freight cars were collected at the larger stations selected for changing couplers during the night.

There were a total of 221 such stations and as fast as the cars arrived at the changing stations they were arranged at regular intervals of about 40 ft., buffer to buffer.

The plans required that the cars be arranged by 5 a. m. and the work of changing commenced at that time and finished by 7 p. m. It so happened that the work was started at some stations as early as 4 a. m., part of the work being done on the previous day. All of the change-over work on the Sendai division was completed before noon. The work was finished on the Kobe division at 4:30 p. m., on the Tokyo division at 5:30 p. m., on the



Drawing showing how the automatic couplers and draft gears were temporarily hung under each car so that they could be easily applied on the day set for completion of the work

Moji division (Sanyo district) at 6:30 p. m., and on the Nagoya at 8:00 p. m.

The privately owned railroads, whose freight cars are operated over the lines of the Government Railways, also changed their couplers at the same time and in the same way. The Government Railways paid about $126 per car as a subsidy.

One of the most important factors of the change-over work was the final inspection. In order that the work of inspection be carried on efficiently, the foremen in the repair shops were previously instructed and these men served as inspectors as well as supervisors of the work.

The old couplers and buffers were loaded into empty cars as fast as they were removed and were not allowed to litter up the yard so as to hinder the progress of the work. They were later sent to various shops to be handled as scrap.

It was feared that many of the workmen might be injured during the work of changing from the old style to the new coupler, because there were many who were not accustomed to such work. The result, however, was satisfactory. There were, of course, a few men injured, but all of these injuries were slight.

Sharon and Alliance type couplers adopted as provisional standard

The Japanese Government Railways before finally deciding on what type of automatic coupler to use, gave serious consideration to the automatic types used in both Europe and America. The A. R. A. standard type "D" coupler was considered too heavy for the rolling stock used on the Japanese railways and it was finally decided to adopt the Sharon type coupler which had given satisfactory service on the Sapporo division. The Alliance coupler was afterward introduced and has proven to be equally as good. These two types of couplers are purchased from America and have been adopted as the provisional standard. They are used on practically all of the rolling stock in Japan. The draft gear is of simple design, consisting of front and rear followers and a coupler yoke to hold the draft gear in position as shown in one of the drawings. This type is considered good enough for the present traffic conditions in Japan, but it will doubtless be necessary to improve the draft gear sooner or later. A new coupler of Japanese design has recently been introduced and it is expected that this type will be extensively used.

As the matter now stands, the coupler problem on the Japanese railways has been solved. The most important parts of the Japanese railways are now under one control and, furthermore, there is no through traffic beyond the Island of Japan. This situation influenced to a large extent the decision to adopt the automatic coupler which was a fairly large undertaking.

This improvement of couplers will undoubtedly aid in the development of traffic and should also provide safer working conditions for the railway employees. It was always a dangerous task to couple cars equipped with the screw and link type coupler, especially in Japan, because the difference between the buffer and the coupler was only 2 ft. from center to center. This is especially emphasized in Table III, which gives the vital statistics showing the number of injuries and deaths in 1922 and 1923 occurring in switching and coupling work.

Table III—Number of injuries and deaths in 1922 and 1923 incurred while coupling cars

Division	Type of coupler	Switching incl. coupling work 1922	Switching incl. coupling work 1923	Coupling work only 1922	Coupling work only 1923
Tokyo	Screw and link	158	177	69	74
Nagoya	Screw and link	116	97	61	30
Kobe	Screw and link	117	134	23	26
Moji	Screw and link	85	114	33	49
Sendai	Screw and link	83	77	41	25
		559	599	227	204
Sapporo	Automatic	41	27	6	0
		600	626	233	204

Protection for acetylene torch outlets

By Charles W. Geiger

At the reclamation plant of the Southern Pacific, Sacramento, Cal., there are nine cutting torch outlets for supplying acetylene gas. The gas is manufactured in a central plant and is piped to all parts of the yard. As shown to the left in the illustration, these outlets are protected by four steel rails bent into the form of a pyramid. This arrangement protects the outlets from being broken or bent by heavy material striking them as it is being handled about the yard. If the operator is using a torch at some distance from the outlet, the hose is carried on metal stands like that shown in the foreground of the illustration. This method of supporting the hose from the ground, protects the hose from being cut or broken by heavy castings falling on it or by trucks being run over it.

View showing reclamation plant of car yard equipped with protective device for acetylene outlet

Three mains lead from the central plant where the acetylene gas is manufactured to the various departments of the general repair shops located at Sacramento. This system of providing gas has proven to be quite efficient in assisting in the performance of the work of the car shop and scrap dock.

THE "BROADWAY LIMITED" and the "American" trains, of the Pennsylvania are to be completely re-equipped with new cars. The Pullman Company is turning out 60 cars for this purpose on rush orders. The new cars will offer many original and novel features of design, including a women's lounge and shower bath and a private office for business men. Interior decoration of a new type will provide a restful atmosphere of soft color harmonies. Of the new cars, 32 will be used on the "Broadway," the 20-hour train between New York and Chicago and 28 on the "American," the 24-hour train between New York and St. Louis.

Utilization of freight cars*

Considered from the viewpoint of loading design and maintenance

By L. K. Sillcox
General Superintendent of Motive Power, C. M. & St. P.

DATA now furnished show the miles per day per locomotive and per freight car. The manner in which the information is compiled is sufficiently divided to enable it to be worked into several factors. We have attempted to gage the performance on the basis of miles per day per locomotive or freight car on line and as a result we have what may be termed a statement of the performance in relation to equipment at hand, rather than a statement of performance of the units actually in service, excluding those stored serviceable or awaiting repairs, etc. In the case of freight cars, it would be necessary to know each day the number out of service for repairs as now shown on the usual form of bad order reports, the number stored serviceable and the number in actual service. When divided in this manner, it is then possible to analyze the performance by hours per day to indicate the dead time encountered in train movements, because this lost motion affects the utilization of cars on the one hand and it is further aggravated by improper facilities respecting sidings, yards, terminals, etc. On the other hand, if we attain the greatest possible net ton mileage with the least actual number of freight cars and freight car miles, then we have a measure of performance which is of benefit to those administering car distribution or those who may largely control their utilzation. If we know that we are handling a certain tonnage with fewer cars today than heretofore, then we should know by what means this is accomplished, so that proper elements may be set up for further improvement.

The primary requisite for a high degree of utilization of freight cars is a condition of favorable road characteristics which permit trains to move without interruption between terminals at a uniform speed. The average speed is now about 12 miles per hour for freight trains, meaning that the distance run between terminals is consumed on this basis, but that at certain intervals a much greater speed is attained in order to maintain this average. The limitations placed upon freight car utilization are, for the most part, not due so much to the character of the equipment as to the obstructions in yard, terminal and road handling.

The amount of freight equipment in the country today is the result of a variety of policies. It is presumed that the administrative methods employed were merely influenced by periods of car shortages and surpluses. This is not so great an element in the question of proper ownership today because there is an ever increasing efficiency in the matter of car distribution throughout the country as a whole. The result is that the car shortages are decreasing and car surpluses are increasing, even in the face of more traffic to be handled. Therefore, the improvement in methods of distribution makes it unnecessary to increase the total number of cars available for service, but rather to replace worn out cars with new units of greater capacity and availability. The increase in the average capacity of freight cars has been 60 per cent since 1902 or from 28.1 tons to 44.5 tons. If we are to attain greater utilization of cars, the increase in capacity will permit this and, at the same time, will require relatively fewer individual units for the service.

We have before us, in this discussion, the question of the general performance of equipment as a whole throughout the country. If the art of design and construction were to develop uniformly, the equipment would reach the obsolescent state at the same time and the problem of overcoming obsolescence by retirements rather than improvements would be greatly simplified. In the past ten years, however, the practice has been to overcome partial obsolescence by improvements, so that the life cycle is indefinite and the character of equipment as to design and construction is not uniform. In this way, there is not as rapid an increase in the average capacity of freight cars as would otherwise be the case. The obsolescence referred is more in the nature of design than resulting from deferred maintenance.

Beyond this we have the problem of the distribution by types. Some carriers have a large majority of open top cars while others may require a large number of house cars. The question of ownership is usually affected by the prevailing character of the commodities handled. Loading in general, or by commodities in particular, is not uniform throughout the year, so that carriers are confronted with high and low peak seasons. If the traffic on each line were confined to cars owned by that line, this would require an ownership capable of taking care of the peak load, so that there would be no shortage throughout a large portion of that time. On the other hand, the interchange of cars is such that ownership for peak loading is not always required and it is this particular feature of car ownership from which results a greater flexibility.

Comparison based on units and capacity of freight cars, showing the saving effected by large capacity cars

	50 ton	40 ton	30 ton
Nominal Capacity			
Limit load on rail in lbs.	169,000	136,000	103,000
Average light weight in lb.	46,000	42,000	36,000
Load carrying capacity in lbs.	123,000	94,000	67,000
Total tons load carrying capacity required	2,400,000	2,400,000	2,400,000
Number of cars involved	39,025	51,064	71,642
Average investment cost per lb. of lt. wght.	3½c.	3½c.	3½c.
Value per car	$1,532	$1,399	$1,199
Total investment	59,786,300	71,438,536	85,898,758
Interest at 6 percent	3,587,178	4,286,312	5,153,925
Net interest saving	1,566,747	867,613	
Maint. cost at 12 per cent of invst. cost	7,174,356	8,572,624	10,307,850
Average per car per year	184	168	144
Saving in maintenance	$3,133,449	1,735,226	
Depreciation, interest, taxes, etc. at 2½%	1,494,658	1,785,963	2,147,469
Savings in depreciation, interest and taxes	652,811	361,506	
Summary of savings	$1,566,747	$ 867,613	
	3,133,449	1,735,226	
	652,811	361,506	
	$5,353,052	$2,964,345	

Comparisons based on the amount of investment in freight cars in relation to the performance as to net tons, miles per unit, or some other such factor, are quite often prepared. Much as in the cases of utilization of power, wherein must be considered the relation of miles per day

*Abstract of paper presented before the Railway Club of Pittsburgh, September 24, 1925.

per locomotive owned and miles per day per locomotive used, we also have to consider some such feature as regards freight cars. However, mileage is so low in freight car performance that to present a factor of relationship of miles per car in service as compared with miles per car on line would not be of any particular moment. We can consider a rather definite factor in the table showing a comparison based on units and capacity of freight cars, thus representing the relation of the carrying capacity requirement, the number of units, the capacity per unit, the investment cost, and the maintenance.

In this illustration it is assumed that the carrying requirements was 2,400,000 tons and that this would be provided either by 30- 40- or 50-ton units. Of course, with larger units it is necessary to provide a smaller number than in the case of smaller units. The average weight per car of different capacities is merely a rough estimate representing all classes of freight cars. This also applies to the average cost per pound and per car, which may be higher for certain classes of cars and possibly lower for other classes of cars. Whether the estimated costs are high or low in this case does not affect the final results materially, nor does it affect the stated savings, because these factors change the results to but a small degree.

In this statement the maintenance is estimated at 12 per cent of the cost of the car per year. The depreciation, insurance and taxes are stated here at the rate of 2½ per cent of the investment. In this respect there is no uniformity of practice, some carriers using one per cent or less for depreciation alone while others employ from four to five per cent. If the case of any carrier could be stated definitely in this form, it would indicate that in the order of importance the possible savings would be in maintenance due to heavier and better cars, representing about 60 per cent of the savings, the reduction in interest amounting to about 28 per cent of the savings, and about 12 per cent representing a possible saving in depreciation, insurance, taxes, etc.

Therefore, there is involved in this question not only the number of cars to be operated, but the average capacity. In order to attain greater utilization of equipment, it would be possible, in theory, to reduce the number of car miles per day, per month or per year and increase the net ton miles with the larger car, provided the movement of commodities permitted of full loading and reduced the proportion of l.c.l. loading. The net tons per train have increased, in the past 20 years, far more rapidly than the cars per train. This movement has been gradual. We may expect that commodities will be moved in such a manner as to permit increasing the average load per car, and with this movement the tendency towards providing larger and heavier cars is continued. In the past few years the average tons per car did not increase at the same rate as the average capacity per car. It should be understood that since the increase in the size of trains, the gross tons per train, etc., with the advent of larger power, it has been necessary to strengthen freight cars. It is, therefore, inconsistent to employ a mandatory strength requirement if the capacity is not increased accordingly, because it is not economical to provide strength of members and fail to have capacity comply therewith. In the past 20 years freight cars have increased in capacity, and consequently, in relative strength, about 60 per cent, whereas, during the same period average locomotive tractive force increased 100 per cent, thus illustrating the great need of building up car members to meet such conditions. The average weight per car did not increase in the same proportion as the capacity.

Under present methods of recording miles per day per freight car it would appear that, considering a bad order situation of eight per cent and an average mileage per car per day on line of 27, by deducting the eight per cent we have an average mileage per serviceable car of 29 per day. Then assuming that the average speed of freight trains is 12 miles per hour and the distance run is 29 miles per serviceable car per day, this would result in an actual period of 2.42 hours in train service out of every 24 hours. This would leave 21.58 hours per day consumed in loading, unloading, switching and other time of an apparently unproductive nature. The above is based upon the action of serviceable cars, but although not representing the actual condition, is merely offered as an illustration. If this were confined to cars actually in trains, it would result in more than 2.42 hours per movement or per day. Nevertheless, we are seriously confronted with the duty of attaining more miles per serviceable car and for that matter obtaining more miles for total cars.

The mechanical department is concerned in this performance in that more cars should be made available for service. It is economical to have a high degree of maintenance or a good condition of equipment. This is illustrated by the following:

All class railroads—Period of four years—1920-21, 22 and 23 (Based on I. C. C. reports.)

Carriers having per cent of bad order freight cars. From	To	Ave. cost per car per year for repairs.
0	5	$151
5	10	179
10	15	186
15		187

The records show that the better equipment is maintained, the less it will cost to keep in condition.

If the bad order situation is reduced but the hours of service per car are not increased, then there is a lack of proper utilization. We have periods of surplus and periods of shortage and it would seem that the policy recommended for locomotives could well be followed for freight cars in that when loading is low, cars can be set aside so that as few as possible will be in actual service. It is recommended that the utilization of cars be interpreted to mean that the greatest amount of tonnage and mileage be attained with the least possible number of units.

The employment of freight cars, when based on net ton miles, can improve most effectively where the increase in the average capacity of cars and their assignment to the fullest possible loading is fully applied. The miles per run per load is also a factor in this measure of performance.

Cars are now loaded to approximately 60 per cent of their capacity, but this factor cannot be considered as improper utilization since greater volume, in relation to weight, is experienced with certain classes of loading. Automobile and furniture loading will illustrate this point. The loaded car miles per loaded car per day is a measure well worth considering in attempting to increase the service of freight cars.

The per cent of loaded to total car miles is a very important feature in proper utilization in that, if the loaded percentage is small, the elements which build up revenues are not favorable. If the net ton miles per loaded car are high, but the percentage of loaded to total car mileage is low, then we still have a situation which is not favorable to intensive utilization. If the loaded movement is all one way, this also affects performance.

Loading

The loading characteristics throughout the country indicate the heaviest tonnage to be in products of the mines. Then in order come manufacture, agricultural, forest, and animal products. The number of car loads handled

in 1924, together with the average load per loaded car, was as follows:

Classification of car loads handled in 1924

Products	Loaded Cars handled	Average Load Per car, tons
Mine	12,794,674	48.5
Manufacturing	9,921,986	23.8
Agricultural	4,758,344	21.8
Forest	3,780,341	24.6
Animal	2,356,574	12.8
Total	33,611,919	34.0

The product of mines not only represent the greatest amount of tonnage handled but permits of a heavy loading per car. This amounted to an average of 48.5 tons. Here we are permitted to load cars to full capacity with the possibility of decreasing car movement and mileage by having cars of greater capacity or of a convertible type. One line in the east has gone to the large dimensioned car very extensively and have some with a capacity of 120 tons. It is in this section of the country where the average load per car ranges between 55 and 60 tons. The heaviest average tonnage per loaded car comes from iron ore mines. This amounted to an average of 53.5 tons, with a range between 63.1 on one road to 43.1 on another, depending on the size of equipment offered by the various carriers for such loading. Bituminous coal offers the next highest average loading or 51.7 tons with a range from 72.0 to 26.2 tons. The spread is rather radical, but is due to the greater distribution of coal fields and a greater variety of equipment offered for loading. Bituminous coal loading constitutes approximately one-half of the total products of mines. Practically all of the products of mines require open top cars.

Manufactured articles occupy the second place in the total movement of car loads, but represent a very low average tonnage, this being 23.8. This is due to the character of the commodities in this group, most of which have a high displacement or require more space per pound of weight than products of mines. The greatest average loading in this group was represented by pig iron or 40.9 tons per car. Cement resulted in 38.0 tons per car. Most of the manufactured articles require house cars. Automobiles offer the least tonnage per car, this average being 8.2.

Agricultural products called for 4,758,344 loads, but gave an average of only 21.8 tons. The load is higher than the average in the Northwest region for the reason that wheat offers the heaviest tonnage in this group, or 40.8. Cotton is responsible for the lightest tonnage or 11.3. Products of agriculture require mostly house cars.

The products of forests offer only 28.1 tons per car, the heaviest being logs and the lightest miscellaneous lumber. This movement requires flat, gondola and house cars.

Products of animals offer a low loading, especially for live stock. Leathers and packing house products offer the heaviest loading, but the average for all is only 11.8 tons.

Design

Until recently the question of design and interchangeability of parts, while covered in a general way in the A. R. A. manual, was not extended to various members in the body. Standard designs are being fully worked out with a view to attaining the greatest possible strength and capacity with the least possible weight. The tendency is to increase the capacity of the cars, which places upon all concerned the duty of increasing the performance of each car required for loading. The tare weight is a feature of design which has been given much consideration. The tare weight of low capacity cars is greater than high capacity cars when measured by tons capacity. This is shown in the following statement in a very general way:

Nominal tons capacity	Tons av. weight loaded	Tons av. tare weight	Per cent of tare to total	Per cent of carrying capacity total weight
30	48	18	37.5	62.5
40	61	21	34.4	65.6
50	73	23	31.5	68.5

These figures represent stenciled capacity and make no allowance for permissible axle loads. From this it may be stated that the percentage of dead weight decreases with the increase in capacity, or in other words the non-productive weight does not increase in proportion with the capacity. This is another argument, especially when actual allowable axle loads are considered, for larger but fewer cars to handle the traffic wherever loading will permit.

The rolling friction increases as the number of bearing surfaces increase. The following shows how this is worked out:

Variation in resistance in relation to variation in light weight of freight cars

Tons light weight per car	Per cent increase	Pounds of resistance per ton weight of car	Total resistance for light weight of car in lb.	Per Cent increase
20		7.00	140.00	
25	25.00	5.89	142.25	1.4
30	50.00	5.13	153.90	9.0
40	100.00	4.20	168.00	20.0
50	150.00	3.64	182.00	30.0
60	200.00	3.27	192.20	40.0
70	250.00	3.00	210.00	50.0

The proportionate increase in resistance is about one-fifth the proportionate increase in weight. Wind friction is reduced with fewer and larger cars per train.

Design is mostly concerned, however, with strength of materials and with the arrangement of parts. The objective should be to provide a unit which will run, as a whole, from one heavy repair to another with a minimum of intermediate attention. The question of larger cars is also involved. Where there are fewer larger cars constituting a train, the length is less for the tonnage carried. This also simplifies the making up and breaking up of trains as there are fewer cars to handle.

Maintenance

It is usual to judge maintenance by the bad order car situation. If we were in a position where a constant car shortage existed, then the question of the number of days cars are detained for this purpose would be of extremely great importance.

There is now developing a greater tendency towards making classified repairs to freight cars on somewhat the same principle as applies to locomotives. The latest development along this line is to provide facilities and forces so as to run a greater number of cars of the same type and design through shops in a short period of time doing practically the same amount of work on each car. Where this work is heavy enough, it should finally result in a service cycle between classified repairs of approximately eight years. This should be done with a view to reducing intermediate light and running repairs in the meantime. In the long run this will result in providing more service days per car. The development of lay-outs and spacing of car repair terminals has not always been according to a specific plan. For this reason, much remains to be done in the matter of location and type of facilities for freight car repairs. A system having 80,000 cars and an average cycle of eight years between heavy repairs would have to run 10,000 cars through the shops each year provided the repairs came due in order. With facilities adapted to such a plan, it might be found that the number of light and running repair points could possibly be reduced, especially if a plan could be worked out

to have greater distances between train classification terminals, where facilities are constantly employed.

While we are wrestling with causes, methods, fundamentals and ultimates, it would be well if we could rearrange our thinking on a factor which exerts a primary as well as a more direct influence than any other feature on the efficiency with which shop operations are handled, namely, that of employing a minimum steady satisfied force, also a minimum number of thoroughly modernized plants and having car maintenance work handled in an orderly fashion throughout the year rather than to follow seasonal demands. If we are to effect the greatest return from a minimum force of men, the least outlay for fixed facilities, and the smallest number of cars to handle a given volume of business, such a plan should receive careful thought. This necessitates the preparation of a budget in which the funds available are allotted to those projects which it is considered most important to carry on. When this budget is approved and the amount of work to be done fixed, it is then necessary to prepare a program or schedule so that the projects may be carried out to the best advantage. It is highly essential that the budget be approved and the program completed sufficiently in advance to enable the materials to be assembled and the forces to be organized to do the work in a logical fashion.

Decisions of the Arbitration Committee

(*The Arbitration Committee of the A.R.A. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.*)

Car damaged due to ice in brake dog

On January 4, 1924, car No. 2935 owned by the Union Refrigerator Transit Company was damaged in switching service on the lines of the Belt Railway Company of Chicago. On January 9, a copy of the hump rider's damage report, together with a list of defects on the car and the estimated cost of repairs was forwarded to the car owner. The handling line requested that the car owner furnish disposition of the car in accordance with Rule 120. The handling line's report stated that Swift Tank Line car, No. 5996 was switched over the hump and struck the Union Refrigerator Transit Company's car No. 2935 owing to the fact that the rider could not control the car as the hand brake was inoperative, due to the brake dog being clogged with ice. The handling line stated further that it reported the case under A. R. A. Rule 120 and that it complied with all the requirements and conventions of Rules 43 and 120 and as it was not subjected to any of the unfair usage conditions mentioned in Rule 32, the damage was the owner's responsibility. The car owner accepted the statement that the car should have been reported under Rule 120 and accepted its inspection reports as correct showing the nature and extent of damage to the car and also accepted the hump rider's accident report which indicated the circumstances under which the failure occurred but failed to agree as to whether, under the A. R. A. Rules, the handling line or car owner was responsible under the circumstances. The car owner further stated that the failure of U. R. T. car No. 2935 was due entirely to the lack of ordinary care on the part of the handling line and, therefore, should be the handling line's responsibility.

In rendering its decision, the Arbitration Committee stated that, "As the damage occurred due to inoperative hand brake which should have been detected by the handling line prior to dropping the car over the hump, the handling line is responsible."—*Case No.* 1343, *The Belt Railway Company of Chicago vs. Union Refrigerator Transit Company.*

Responsibility for car uncoupled by trespasser

A Belt Railway of Chicago locomotive handling a train of 82 cars was travelling northbound when some one climbed through the train, stepping on the pinlifter of St. Louis-San Francisco car No. 37239, and disconnecting the train. When the slack ran out, the air hose parted, causing the air to set, with the result that the coupler and draft rigging was pulled out of St. L. & S. F. car No. 1261. The handling line contended that the car was damaged in fair service and was not the result of the air being set from the rear end, as intended by the last sentence of Interpretation 5 of Rule 32. The owner stated that it was understood that if a train parted by reason of defective equipment, the car owner will be held responsible but that it does not seem reasonable that a car owner should be held liable for the acts of trespassers, as in this particular case.

The Arbitration Committee rendered the following decision, "Damage occurring under such conditions is not unfair usage as defined by Rule 32. Car owner is responsible."—*Case No.* 1340, *The Belt Railway Company of Chicago vs. St. Louis-San Francisco.*

Responsibility for wrong coupler repairs

According to the repair card dated May 2, 1921, the Louisville & Nashville at its Corbin, Ky., shop, applied to the A end of Atchison, Topeka & Santa Fe car No. 49384, a new 5-in. by 5-in. by 6½-in. coupler and a 1¼-in. by 5-in. by 84 in. coupler pocket. When this car reached its home shop a joint evidence card was secured which showed that at the A end of the car, one coupler 5 in. by 5 in. by 9⅛ in. and one sleeve 1¼ in. by 4½ in. by 9⅛ in. by 32½ in. with plain ends were applied instead of a 5-in. by 5-in. by 6½-in. coupler and a 1¼-in. by 5-in. by 8½-in. by 32½-in. sleeve with reinforced ends, which are standard to the car. The wrong repairs were corrected and the joint evidence, together with the billing repair card was presented to the L. & N. with a request for a defect card. The L. & N. furnished a defect card for the material covering the wrong coupler but refused to allow material for the wrong yoke claiming that the yoke is not an A. R. A. standard, and that under Rule 88 it was responsible for the labor only of correcting the wrong repairs and that this is covered by the coupler operation. The car owner contended that under Rule 17, the repairing line is also responsible for the material to correct the repairs caused by the application of an improper yoke as it was neither A. R. A. standard material nor standard to the car. The car owner also contended that it was a well defined principle of the A. R. A. Rules that the owner's standards must be maintained unless the repairs are made by the substitution of A. R. A. standard material.

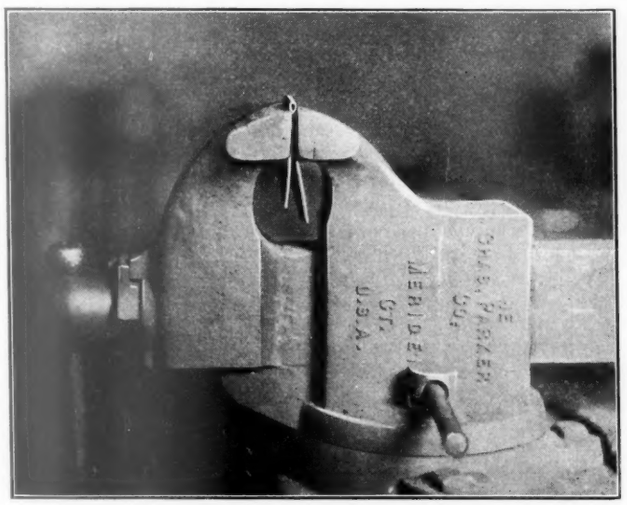
In rendering its decision, the Arbitration Committee stated that, "The contention of the Atchison, Topeka & Santa Fe is sustained. The Louisville & Nashville should issue a defect card to cover labor and material for correcting the wrong repairs made by it.—*Case No.* 1345, *Atchison, Topeka & Santa Fe vs. Louisville & Nashville.*

Shop and employment tests for qualified welders*

By Glenn O. Carter

Consulting engineer, The Linde Air Products Co., New York

SUCCESSFUL welding is built on the basis of qualified welders. This is irrespective of the process, be it oxy-acetylene, electric or hammer. The fact that an operator has proved his ability to make a good weld is by no means a complete assurance that he will never make a poor weld. But a proper test for qualification will make



A good weld will not fail even when bent double

sure that the welder is capable of depositing metal of the strength desired and then if subsequent tests show that workmanship is poor, there can be a definite placing of the responsibility on the welder for failure to do his best. Experience has indicated that welders maintain a high average standard in their daily work.

Qualification tests should be made using almost identically the same materials that the welder will work with. This is of prime importance as welding conditions vary where there are considerable differences in the thickness of the base metal, the composition of the metal and the composition of the welding rod. This is of such importance, that where a man, known to be a good welder on certain materials, is considered for welding on important work with some other material, he should make a qualification test to insure good workmanship. For instance a man who is a good welder on 1½-in. steel plate may be, and probably is, a good welder on heavy cast iron, but it is obvious that the work is of such a different nature that the good steel welder might not be good on cast iron.

The conditions in welding light material of, say, from 20 gage up to 10 gage vary so from welding on ½-in. plate that a check test should certainly be made before a welder accustomed to either weight of steel starts on the other.

How qualification tests should be made

The question now arises as to what is a satisfactory qualification test. In my opinion, a welder should be called on to make a short test weld of from 3 in. to 6 in. or more and this test piece should be cut into strips from 1½ in. to 2 in. wide and the strips tested by bending in a vise or over an anvil. This simple test is effective for judging the ability of a welder. It is, however, one that depends on the judgment of the supervisor and can only be evaluated with difficulty. It shows the soundness of the deposited metal and the amount of penetration.

In most cases, when welding on average materials, the management would not need to carry a test any further, but if a welder is to work on important welding where the joint is to withstand severe loads, an additional test is decidedly advisable. This may involve a real expense for testing, but when the test has been made and results reported, everyone from the engineer who supervises the welding to the management of the welding shop and the welder will be glad to have the information.

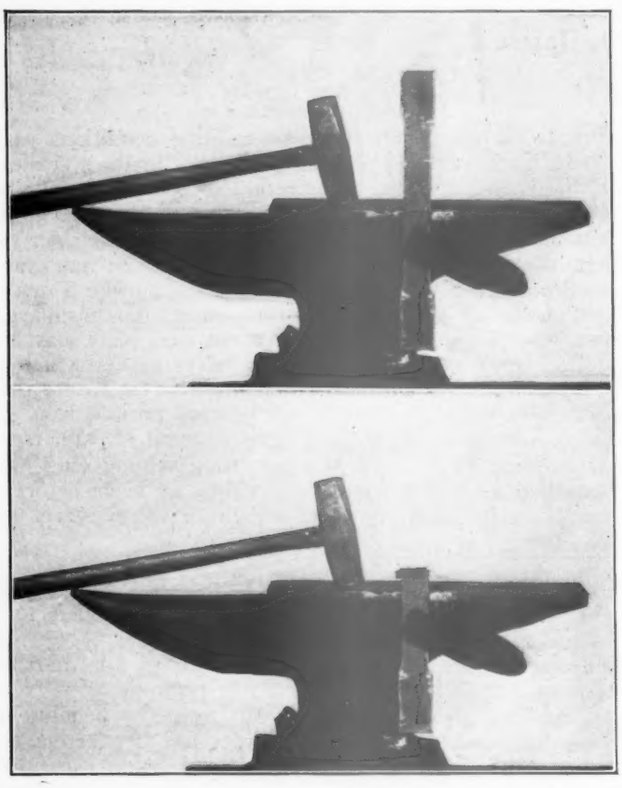
In many cases, applicants for welding work are good

*Abstract of the paper presented before the Metropolitan Section of the American Welding Society, November 13, 1925.

welders with other apparatus than that to be used for the welding considered. Therefore, if a qualifying operator asks to use equipment with which he claims to be familiar or with a different welding head and pressure than is specified for the job, it will be well to let the applicant prove his ability by furnishing him with the desired apparatus. If a man is a good welder with one type of apparatus, it would justify spending a few hours or a couple of days to let him learn how to handle other equipment. The final test should, however, be made with the equipment, the material and under the conditions of the actual work.

For an exact test, it is desirable to have the test pieces made up of material of almost the same thickness and quality as the finished work. It is also advisable to have the test pieces of such size that they can be compared with other test results both in welding and in standard materials.

On this account in plate metal work, test pieces should be 9 in. by 12 in. and if they are to be beveled, the beveling should be along a 12-in. edge. When the weld has been made joining two 12-in. edges, the plate will then be 18 in. long and 12 in. wide. If the plate is of steel, the test pieces can then be roughed out with a cutting torch so as to obtain strips for machining or grinding out five standard A. S. T. M. flat test pieces. If the material is



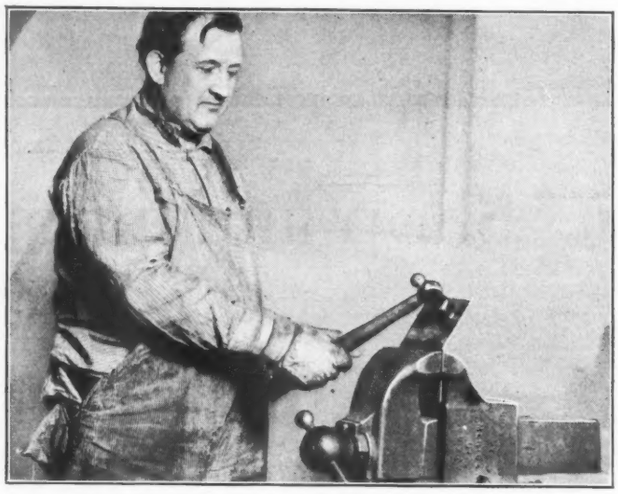
Proper method of clamping a test weld to an anvil—Note that the piece did not break at the weld

other than iron or steel, the plate will have to be cut up into strips on a machine tool.

After the plate is cut into strips, each test piece is then machined out at its central part so that the standard 8-in. test can be marked off over a section which will be 1½-in. wide. There will be some excess metal at the grip as is the regular practice. In cutting the strips from which the test pieces are to be made, it is good practice to cut ½ in. off each end of the weld so that the testing of the workmanship will not be complicated by the starting or the finishing of the welding operation. A properly marked off plate is shown in one of the illustrations.

These test pieces will then be pulled in a tensile test machine and the test reports should show the elastic limit or yield point; the ultimate strength; elongation, both in 2 in. and 8 in. and reduction of area. The report should also indicate the nature of the fracture and if a failure has occurred in the weld, what percentage of the area was not welded on account of the lack of penetration or blow holes.

In some cases the welds are ground flush with the plate, but it is now common practice to leave the welded zone



When testing a weld in a vise, bend it so the top of the weld will be stretched

unground on the flat surfaces as that is the way the weld will be in the finished article. The thickness of the material should be noted as well as the average cross section of the weld zone. If the failure occurs in the weld, the strength of the deposited metal should be calculated both from the cross section area of the zone of fracture and on the basis of the cross section of the plate. If, however, the failure occurs outside of the weld zone, the strength of a test piece should be calculated only on the cross section of the base metal.

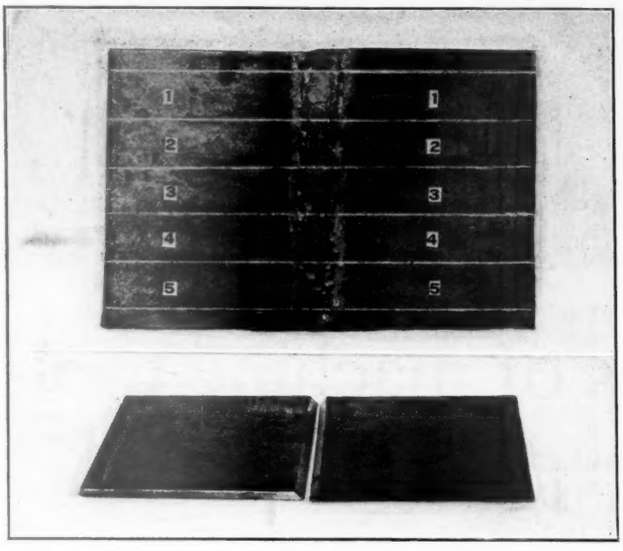
With different grades of deposited metal, different standards should be looked for. In oxy-acetylene welding with Norway iron, which is so low in carbon as to have a maximum strength of about 52,000 to 55,000 lb. per sq. in., a welder should develop a strength of weld through the weld zone of 40,000 lb. per sq. in. for a single vee weld and 45,000 lb. per sq. in. for double vee. With Norway iron, the failure will nearly always occur in the weld, because almost any steel plate is stronger than 45,000 lb. per sq. in.

When welding with nickel steel filler of good quality or with high test welding rod, the failure should occur in the base metal of average steel as frequently as in the weld zone. A qualified operator should develop at least 50,000 lb. per sq. in. with either of these materials or, if he is an excellent operator, his test should develop approximately the full strength of the plate, 60,000 to 65,000 lb. per sq. in.

What the limitations should be for a qualification test with other forms of welding should be left to those thoroughly familiar with the electric arc welding or the hammer welding process as the case may be.

From these standard A. S. T. M. tests we obtain figures which can be depended on to satisfy us as to the ability of any given welder and by building up a series of qualifica-

tion tests we will be building up a history for the welding industry that will materially assist in carrying it ahead in the esteem of engineers. When a welder is making his qualification test, attention should be paid to several things that will have an important bearing on the question of workmanship. Whoever supervises the test should set a maximum time within which the test should be completed because a welder should be expected to do a certain minimum day's work. Attention should also be paid to the size of the welding head which is used for the test work. Manufacturers of blowpipes, will, undoubtedly, specify a certain welding head for any given thickness of metal and



The top view shows method of laying out test pieces on the test weld—The lower view shows the proper position in which to place the test pieces to be welded

it is advisable to have a test conducted under the conditions considered most satisfactory.

Experienced welders know that by using a very carefully adjusted flame, with gas pressures as low as can be carried and still permit operation of the torch without backfiring, a very high quality weld can be made. Such men also know that by taking their time they can make a better weld than they will generally average. The qualification test should not be intended to show what is the very best that a man can do, so much as what he can be counted on to do under working conditions.

Thus, by having the welding heads as called for by the equipment markers and using the pressures specified by them and insisting upon a commercial speed of welding a test piece will be made which gives real information.

We can rest assured, moreover, that if a man makes a satisfactory test piece, even if he has worked a little slower or with a slightly different flame than is his general practice, we will be very much better off than if he did not make a satisfactory qualification test of any kind.

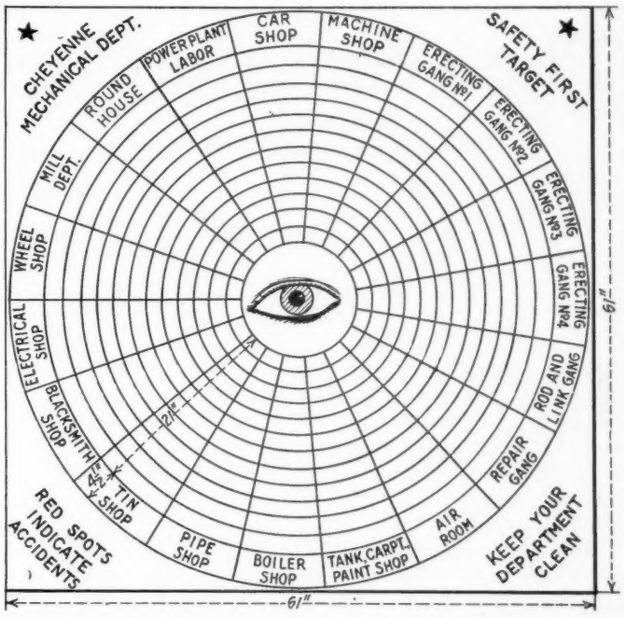
From consideration of the above, it is easy to see that we may divide the work into at least two categories. One is work which must be of the very best quality; here it is important to have the full qualification test and it will be satisfying to everyone to have such tests supervised by competent inspection laboratories. For the other class of work where life is not endangered by the failure of a joint, it is advantageous to have a good check on the welder's ability, but the simpler test which is made by cutting the test piece into strips and bending in a vise is sufficient.

The history of the welding process where real qualification tests have been utilized over a period of years is so satisfactory that we can truthfully say welding is equal in quality to any other type of joint and, of course, in tightness is far superior.

Safety-first target

ONE of the first things to strike the attention of a visitor at the Union Pacific shops at Cheyenne, Wyo., is the large safety-first target illustrated. This target is painted on a substantial board 61 in. square, located near the center of the locomotive shop where it can be readily seen by all who pass the tool room. The background in the circle is black, the corners being green, and lines and letters, white. It will be noted that all the sub-divisions of the shop organization are shown on this target and competition in safety work is thus encouraged between the different gangs. The radii of the circle are divided into 12 spaces, one for each month, and when a reportable accident occurs in one of the shop gangs a red spot in the appropriate space indicates that that gang has overlooked one dangerous practice, and must be on the alert to avoid another.

The results of the safety campaign at Cheyenne shops have been highly commendable, the last reportable per-



A target which shows the standing of all departments of the locomotive shop with respect to personal injury accidents

sonal injury occurring on October 11, 1924. The man-hours worked since are shown in the table:

Man-hours since last reportable injury—Cheyenne shops, Union Pacific

October, 1924	258,369
November, 1924	191,137
December, 1924	180,526
January, 1925	189,962
February, 1925	208,142
March, 1925	215,426
*April, 1925	189,596

*The last month for which figures were available when this article was prepared.

One way in which it has been found practicable to direct additional attention to the safety-first target is to post notices regarding matters of general interest, such as inter-department ball games, safety-first meetings, etc., under the target. These news items are changed from day to day and the men therefore get in the habit of watching the board.

The year's purchases of machine tools

Lists from 88 roads show practically the same number of units bought in 1925 as were bought in 1924

By L. R. Gurley

LAST year's January issue of the *Railway Mechanical Engineer* contained for the first time, a tabulation of machine tools purchased by 85 railroads in North America, which represented 77 per cent of the total route mileage on this continent. Through the co-operation of the railroads it is now possible to publish similar lists for another year.

The data now available, which represents two years' purchases, is not sufficient from which to draw any final conclusions as to the trend with respect to the types of machines purchased or the long time trend of the railway market as a whole. However, certain interesting indications begin to appear. Using the 1924 list of machine tools purchased as a basis of comparison, the number of tools of the same classes purchased this year is only 33 units or two per cent less than those reported for 1925. Furthermore, the proposed machine tool expenditure for 1926 compares closely with the expenditures which were proposed a year ago for 1925. The budget figures for the purchases of machine tools by 19 railroads in the United States, which represent 27 per cent of the total route mileage, show proposed expenditure of $3,142,796 for 1926, as compared with $3,162,382 which the same roads proposed to spend during 1925. These facts indicate that the railway purchases of machine tools are not affected by the same conditions as was the car and locomotive market during the past year, and point strongly to the stability of the railroad market for machine tools.

The list of the various types of machine tools purchased has been enlarged to include not only blacksmith, boiler and car shop metal working or forming machinery such as bulldozers, bolt machines, steam hammers, flue welding machinery, punches, shears, riveters, presses, etc., and car shop woodworking machines, as well as the metal cutting machines commonly classified as machine tools, but also to include other shop facilities such as shop trucks, overhead cranes, car and locomotive hoists and small shop hoists, together with furnaces, motors, generating sets, air compressors and welding equipment.

Comparison of types purchased

On page 105 of the January 2, issue of the Railway Age will be found an article on "Machine Tools Purchased During 1925" which contains two tables giving in total numbers the various types of machine tools and shop equipment purchased by 88 railroads in North America which represent 77 per cent of the total route mileage. These figures show that the railroads purchased 310 lathes, 179 drill presses, 104 planers, shapers and slotters, 69 boring mills, 38 milling machines, 291 grinding machines, 58 portable boring, facing and turning machines, 93 bolt and pipe cutting and threading machines, 82 power presses, 56 hammer and forging machines, 119 boiler shop machines, including punches and shears and 160 woodworking machines. The shop equipment figures show that the railroads also purchased 97 blowers for forges, ventilating systems, etc., 159 furnaces, 23 overhead cranes, 14 car and locomotive hoists, 230 air, electric and chain hoists, 131 shop trucks, 85 truck trailers, 24 air brake test racks, 54 air compressors, and 110 electric welding sets.

There are certain machine tools which are standard equipment to all railway shops, the purchase of which varies but little. For example, 337 lathes, 178 drill

presses, 127 planers, shapers and slotters and 80 boring mills were purchased in 1924, as compared with 310, 179, 104 and 69, respectively, of the same tools purchased during 1925.

During the past few years, considerable attention has been given to the place which grinding machines should take in the railroad shops. That this is making itself felt in the selection of production machines for the railroad shops, is evidenced by the fact that during 1924, 240 grinding machines were purchased, while the 1925 purchases were 291.

To facilitate the servicing of locomotives at terminals, as well as for use in the back shop, the railroads are buying portable tools, such as lathes, boring, facing and turning machines and welding equipment. Last year 58 portable boring, facing and turning machines, 5 portable lathes and 110 electric welders, were purchased.

In spite of the tendency to replace wood cars with steel cars the purchase of woodworking machinery has increased from 146 units in 1924 to 160 units in 1925. As pointed out last year, wooden passenger cars are fast disappearing but it will be many years before freight cars are all built of steel, if, indeed they ever are. So the demand for woodworking machinery continues.

Material handling equipment

The railroads are not only purchasing modern machine tools to reduce maintenance costs but are also buying material handling devices and other shop equipment the purpose of which is to facilitate shop methods. The large number of units of this equipment listed for the first time this year indicates the type of labor-saving facilities with which the railroads are supplementing their new machine tools. Cars and locomotives can be handled by either overhead cranes or hoists. The lists include 23 of the former and 14 of the latter. The purchases also include 230 air, electric and chain hoists, used for lifting car and locomotive parts. The production of modern machines as well as repair output of the shop as a whole depends somewhat on the adequacy of intra-shop transportation facilities for the movement of material. In the past, this transportation has been provided by hand trucks which the railroads have been somewhat slow in replacing with power trucks. That some improvement is being effected, however, is evidenced by the fact that 114 electric trucks and 16 gasoline trucks were purchased last year, together with 85 trailers for use with the power trucks.

Furnaces and blowers are used extensively in the boiler shop, flue shop, blacksmith shop and in the car department. Among the smaller types of furnaces are listed 29 electric, 63 oil, as well as a number of equipments for such purposes as tempering and brass melting, some of which are gas fired. The larger type of furnaces listed include 17 furnaces for plate heating, annealing and forging work. The railroads purchased 26 pressure blowers and 31 forge blowers.

The railroads bought 24 air brake test racks last year. Fifty-four air compressors of various types were also purchased for shop use.

The lists show the purchase of 110 electric welders. Two complete acetylene gas generating sets were also included. As these plants, however, are frequently not owned by the railroads where they are installed, others may have been placed in service during the year, under leasing arrangements. Much small gas welding equipment, such as torches, regulators, gages, etc., has not been listed because of space limitations.

The lists included with this article give in as complete detail as possible the number, size or other capacity designation and type or kind of equipment purchased by each railroad during 1925 for which the data are available. The name of the builder or company from which the equipment was purchased is included where possible.

The machine tools and shop equipment purchased by the railways in 1925

Alabama, Tennessee & Northern

No.	Size and capacity	Type of machine	Builder or dealer
1	14-in. by 6-ft.	Engine lathe	Carroll & Jamieson

Alton & Southern

No.	Size and capacity	Type of machine	Builder or dealer
1	42-in.	Upright drill	W. F. & J. Barnes Co.
1	No. 3	Tool grinder	U. S. Electrical Tool Co.

Ann Arbor

No.	Size and capacity	Type of machine	Builder or dealer
1	6-ft.	Radial drill	Emerson Tool Works
1	No. 18	Hack saw	F. C. Atkins & Co.

Atchison, Topeka & Santa Fe

No.	Size and capacity	Type of machine	Builder or dealer
2		Car Axle and journal turning lathes	Niles-Bement-Pond Co.
2	16-in. by 6-ft.	Portable engine lathes	Manning, Maxwell & Moore
1	20-in. by 8-ft.	Engine lathe	Niles-Bement-Pond Co.
1	24-in. by 16-ft.	Engine lathe	Cisco Machine Tool Co.
1	32-in. by 14-ft.	Engine lathe	Manning, Maxwell & Moore
1	36-in. by 16-ft.	Engine lathe	Manning, Maxwell & Moore
1	6-ft.	Radial drill press	Smith-Booth-Usher Co.
3	24-in.	Sensitive drill presses	E. L. Essley Machinery Corp.
1		Upright drill press	Smith-Booth-Usher Co.
1	32-in.	Single head shaper	Stocker-Rumely-Wachs & Co.
1	32-in.	Invisible type crank shaper	Marshall & Huschart Mchy. Co.
1	36-in.	Draw cut shaper	Morton Manufacturing Co.
1	24-in.	Crank slotter	Marshall & Huschart Mchy. Co.
1	48-in.	Car wheel boring machine	Niles-Bement-Pond Co.
1	60-in.	Vertical boring mill	Cincinnati Planer Co.
1		Single wet emery grinder	Manning, Maxwell & Moore
5		Double end emery grinders	Scott-Ransbach Machinery Co.
1		Metal cutting off saw	Smith-Booth & Usher Co.
5	2-in.	Double head bolt cutters	Marshall & Huschart Mchy. Co.
2		Double head bolt cutters	Herberts Machinery & Supply Co.
1		Nut tapping machine	Manning, Maxwell & Moore
2	No. 302-B	Pipe and nipple machine	Manning, Maxwell & Moore
1	1½-in.	Bolt heading machine	Manning, Maxwell & Moore
1	100-ton	Driving box press	Manning, Maxwell & Moore
1		Portable crank pin press	Watson Stillman Co.
1	4,000-lb.	Steam hammer	Manning, Maxwell & Moore
1		Couple yoke riveter	Hanna Engineering Works
1		Pneumatic flue swedging machine	Manning, Maxwell & Moore
1		Flue furnace (oil)	Mahr Manufacturing Co.
1		Furnace (oil)	DeRemer & Blatchford Co.
1	4-ft. by 40-ft. by 30-in.	Annealing furnace	Mahr Manufacturing Co.
1	11-ft. by 11-ft.	Plate annealing furnace	DeRemer & Blatchford Co.
1	No. 70	Draft and motor fan	Buffalo Forge Co.
4		Electric ventilating fans	Garden City Fan Co.
7		Pressure blowers	Mahr Manufacturing Co.
12		Soot blowers	Diamond Power Specialty Co.
1		Hand power post drill	H. Channon Company
1	20-in. my 6-ft.	Heavy compound type post borer	Greenlee Brothers Co.
1	No. 177	Single surfacer	Yates Machine Co.
1		Double surfacer	Yates Machine Co.
2	16-in.	Rip and cut-off saws	Yates Machine Co.
2	Double Arbor	Universal saw benches	Greenlee Brothers Co.
1		Self feed rip saw	Yates Machine Co.
1	15-ft.	Planer and matcher	Yates Machine Co.
1	No. 91	Planer and matcher	Yates Machine Co.
1	C-4-A	Moulder	Yates Machine Co.
1	No. 430	Belt sander	Yates Machine Co.
1		Shavings exhaust system	Chicago Blow Pipe Co.
1	30-ton	Electric traveling crane	Manning, Maxwell & Moore
1	12-ton	Heavy turntable	Canton Foundry & Machine Co.
2	½-ton	Air hoists	Chicago Pneumatic Tool Co.
1	1-ton	Air hoist	Chicago Pneumatic Tool Co.
1	1-ton	Air hoist	Independent Pneumatic Tool Co.
22	1½-ton	Air hoists	Independent Pneumatic Tool Co.
5	2-ton	Air hoists	Independent Pneumatic Tool Co.
4		Air hoists	Chicago Pneumatic Tool Co.

Atchison, Topeka & Santa Fe (Continued)

No.	Size and capacity	Type of machine	Builder or dealer
1	No. 5	Universal air motor and winch	Chicago Pneumatic Tool Co.
1	2-ton	Geared hoist	Chicago Pneumatic Tool Co.
1	2-ton	Stiff leg post crane	Chicago Crane & Hoist Co.
5	1½-ton	Bracket cranes	Joseph T. Ryerson & Son
1	2-ton	Geared trolley	Scully Steel & Iron Co.
3		Gearey trolleys	Higgins & Co.
26		Bracket cranes, geared trolleys	Joseph T. Ryerson & Son
1		Hand traveling crane	Whiting Corporation
2		Propelled trucks	Elwell Parker Electric Co.
6	3½-ton	Trailers	Mercury Manufacturing Co.
1	3-U.	Test rack	Westinghouse Air Brake Co.
2		Triple valve test racks	Westinghouse Air Brake Co.
2		Air compressors	Chicago Pneumatic Tool Co.
1		Truck battery charging plant	Electric Products Co.
1	3-hp.	Induction motor	General Electric Co.
1	3-hp.	Motor	Allis Chalmers Manufacturing Co.
1	20-hp.	D. C. Motor	Westinghouse Electric & Mfg. Co.
1	25-hp.	D. C. Motor	Westinghouse Electric & Mfg. Co.
1	30-hp.	Motor	General Electric Co.
1	40-hp.	Motor	Westinghouse Electric & Mfg. Co.
2	40-hp.	D. C. Motor	Western Electric Co.
1	75-hp.	Motor and starter	Westinghouse Electric & Mfg. Co.
1		Motor and starter	Westinghouse Electric & Mfg. Co.
1	500-k. v. a.	Generating set	Westinghouse Electric & Mfg. Co.
1	7½-k.w.	Turbine generator set	Brown Hoisting Machine Co.
1		Motor generator set	Electric Products Co.
1		Electric welding generator set	General Electric Co.
1		Welding motor-generator set	Westinghouse Electric & Mfg. Co.
3	25-k. v. a.	Transformers	Westinghouse Electric & Mfg. Co.
1		Electric arc welder	Westinghouse Electric & Mfg. Co.
1		Portable elec. arc welder	General Electric Co.
3		Electric butt welding machines	Thompson Electric Welding Co.
1		Testing machine	Tinius Olsen Testing Machine Co.

Atlanta & West Point

1	6-in. by ¼-in.	Nibbling and trimming machine	
1		Stay bolt threader	Warner & Swasey Co.
1	3,500-lb.	Pneumatic press	Southwark Foundry & Machine Co.
1	35-ton, 8-in. ram	Hydraulic spring testing press	
1	100-ton, 12-in. ram	Hydraulic spring stripping press	
1	7¾-in. by 14⅛-in.	Hydraulic spring banding press	
1	5/8-in. by 7-in. by 72-in.	Elliptic spring former	
1	4-ft. by 15-ft.	Annealing furnace	Deremer-Blatchford Co.

Atlantic City Railroad

1	⅛-in. to 2½-in.	Tool and twist drill grinder	Bridgeport Safety Emery Wheel Co.

Atlantic Coast Line

2	14-in. by 6-ft.	Lathes	Rahn-Larman Co.
2	18-in. by 10-ft.	Tool room lathes	Manning, Maxwell & Moore
1	24-in. by 26-in.	Libly Type C lathe	Manning, Maxwell & Moore
1	20-in.	American lathe	Regar Co.
2	20-in.	Brass lathes	Manning, Maxwell & Moore
3		Lehman lathes	Carey Machine & Supply Co.
1		Turret lathe	Warner & Swasey
2	6-ft.	Radial drills	Smith-Courtney Co.
1	No. 3	Swing drilling machine	Manning, Maxwell & Moore
1	6-spindle	Arch bar drilling machine	Niles-Bement-Pond Co.
2	32-in.	Shapers	Ohio Machine Tool Co.
1	36-in. by 44 in.	Side head boring mill	Niles-Bement-Pond Co.
1	52-in.	Car wheel boring machine	Consolidated Machine Tool Corp.
1		Driving box borer & facer	Wm. Sellers & Co., Inc.
1		Vertical rod miller	Consolidated Machine Tool Corp.
1		Piston rod grinder	Norton Co.
2	FG	Internal grinders	Manning, Maxwell & Moore
1	No. 475	Oilstone tool grinder	Manning, Maxwell & Moore
1		Side head grinder	
3		Chambersburg wheel presses	Manning, Maxwell & Moore
1	2-ton	Chambersburg steam hammer	Manning, Maxwell & Moore
1	type D	Adjusting machine	Walter Stock Adjusting Machine Co.
1	No. 5	Beam and plate punch	Consolidated Machine Tool Corp.
1	No. 40	Rotary shear	Manning, Maxwell & Moore
1	No. 14	Bar shear	Consolidated Machine Tool Corp.
1	No. 26	Combined punch and plate shear	Henry Pels & Co.
1	No. 7	Plate bending rolls	Consolidated Machine Tool Corp.
1	2,500-lb.	Plate bending rolls	Monarck Engineering & Mfg. Co.
1		Tempering furnace	Strong, Carlisle & Hammond Co.
2	No. 2	Electrode rivet heaters	American Car & Foundry Co.

Boston & Maine

No.	Size and capacity	Type of machine	Builder or dealer
1	90-in.	Journal lathe	Manning, Maxwell & Moore
2		Putnam axle lathes	Manning, Maxwell & Moore
1	8-in.-26-in.	Libby turret lathe	International Machine Tool Co.
1	4¼-in. by 8-in., to 5½-in. by 10-in.	Journal broaching machine	Ar-An-Ess Manufacturing Co.
1	32-in.	Stockbridge shaper	Niles-Bemnet-Pond Co.
1	42-in.	Vertical turret lathe	Bullard Mach. Tool Co.
1		Sunstrand internal grinder	Manning, Maxwell & Moore
1	12-in. by 36-in.	Multi-purpose grinder	Norton Company
1	30-in.	Knife grinder	S. A. Woods Machinery Co.
1	Type A	Traverse grinder	Norton Company
1	No. 2	Horizontal cock grinder	Turner Foundry & Machine Co.
1		Valve finishing machine	Walter H. Foster Co.
1	K	Band saw filer and setter	Oliver Machinery Co.
1		Band saw brazer	Oliver Machinery Co.
1		Filing machine	Machinery Dealers, Inc.
1	8-in. by 8-in.	Hack saw	W. Robertson Machine & Fdy. Co.
1	8-in. by 18-in.	Hack saw	W. Robertson Machine & Fdy. Co.
4	No. 2	Crank pin turning machines	H. B. Underwood Corp.
1	4-spindle	Bolt turning machine	Walter H. Foster Co.
1	6-spindle	Turning and threading machine	Walter H. Foster Co.
1		Centering machine	Walter H. Foster Co.
1	Type A	Pipe bender	American Pipe Bending Mach. Co.
1	No. 2	Spring former	J. T. Ryerson & Son
1	1,500-lb.	Steam hammer	Chambersburg Engineering Co.
2	400-lb.	Hammer	Nazel Engineering & Mach. Works
1	¾-in.	Flanging machine	McCabe Manufacturing Co.
1	20-in. by 16-in.	Timber sizer	P. B. Yates Machine Co.
1	No. 71	Wilkins channeler	P. B. Yates Machine Co.
3	3,000-lb.	Crane trucks	Elwell Parker Electric Co.

Buffalo, Rochester & Pittsburgh

1	200-ampere	Arc welder	Westinghouse Electric & Mfg. Co.

Canadian Pacific

1	No. 4	Niles car wheel lathe	J. Bertram & Sons
1	2½-in.	Turret lathe	Acme Machine Tool Co.
1	No. 1-A	Turret lathe	Warner & Swasey Co.
1	20-in.	Vertical drill	Williams & Wilson, Ltd.
1	48-in. by 48-in. by 12-ft.	Planer	Canadian Machy. Corp.
1	26-in.	Shaper	J. Bertram & Sons
1	36-in.	Shaper	Canadian Machy. Corp.
1	60-in.	Boring mill	J. Fertram & Sons
1	54-in.	Knife grinding machine	Rogers Machinery Co.
1		Chaser grinder	Geometric Tool Co.
1		Cock grinder	Warner & Swasey Co.
1		Band saw filing machine	The Wardwell Manufacturing Co.
2	16-in.	Swing cut-off saw	Jackson Cochrane Co.
2	9-in.	Hack sawing machines	Racine Tool & Machine Co.
1	2-in.	Pipe threading machine	Landis Tool Co.
1	6-in.	Pipe threading machine	Williams Tool Corp.
1	4-in.	Centering machine	Hendey Machine Co.
1	⅛-in. by 8-ft.	Squaring shear	Niagara Machine & Tool Works
1	No. 40	Rotary shear	Quickword Company
1	No. 1	Punching machine	J. Bertram & Sons
2	84-in.	Spring forming machine	Jos. T. Ryerson & Son
1	6-ft.	Gap rivetter	Hanna Engineering Works
1	No. 10	Blast fan	Buffalo Forge Co.
1	8-in.	Moulder	Freston Woodworking Mach. Co.
1	No. 600	Rip saw	Canadian Machy. Corp.
1		Mitre saw	Canadian Machy. Corp.
1		Tenoner	Preston Woodworking Machy. Co.
4	25-ton	Car hoists	Whiting Corp.
9	5-ton	Pneumatic hoists	Chicago Pneumatic Tool Co.
1	5-ton	Caterpillar tractor	Holt Manufacturing Co.
2	200-amp. d.c.	Welding sets	General Electric Co.

Central of Georgia

1	No. 3	Double axle lathe	Niles-Bement-Pond Co.
1	14-in. by 6-ft.	Engine lathe	American Tool Works
2	15-in.	Engine lathe	R. K. LeBlond Machine Tool Co.
1	16-in. by 8-ft.	Engine lathe	American Tool Works
1	102-in.	Tire turning machine	Niles-Bement-Pond Co.
1	1½-in. by 10-in.	Universal turret-screw machine	Warner & Swasey Co.
1	4-ft.	Radial drill	American Tool Works
1	52-in.	Boring mill	King Machine Tool Co.
1	30-in.	Bar grinder	Diamond Machine Co.
1		Internal grinder	Gisholt Machine Co.
5	18-in. by 3-in.	Floor grinder	Hisey-Wolf Machine Tool Co.
1	4-in. by 8-ft.	Boring bar	H. B. Underwood Corp.

No.	Size and capacity	Type of machine	Builder or dealer
2		Blowers	P. H. & F. M. Roots Co.
1	No. 283-P	Car mortiser	Greenlee Brothers & Co.
1	5-ton	Electric traveling crane	Niles-Bement-Pond Co.
1	7½-ton	Electric traveling crane	Niles-Bement-Pond Co.
1	5-ton	Pneumatic hoist	Detroit Hoist & Machine Co.
3	2,000-lb	Electric hoists	Shepard Electric Crane & Hoist Co.
1	1-ton	Hand operated crane	Armington Engineering Co.
6		Portable electric welders	Westinghouse Electric & Mfg. Co.

Baltimore & Ohio

1	90-in.	Journal lathe	Manning, Maxwell & Moore
1	16-in. by 6-ft.	Engine lathe	Girard Machinery Co.
1	26-in. by 12-in.	Cisco-geared head engine lathe	Girard Machinery Co.
2		Bench lathes	L. A. Benson Co.
1	4-ft.	Dresses radial drill press	Manning, Maxwell & Moore
1	20-in.	Barnes Upright drill press	Manning, Maxwell & Moore
1	15-in. by 18-in.	Upright drill press	Kemp Machinery Co.
1	24-in.	Columbia high-duty shaper	Manning, Maxwell & Moore
1	24-in.	Columbia crank shaper	Manning, Maxwell & Moore
1	36-in.	Open-side crank planer and shaper	Manning, Maxwell & Moore
1		Draw-cut shaper	Morton Mfg. Co.
1	48-in.	Car wheel borer	Manning, Maxwell & Moore
1	100-in.	Vertical boring & turning mill	Wm. Sellars & Co., Inc.
1	No. 2	Universal grinding machine	Landis Machine Co.
1	No. 6	Dexter valve reseating machine	Leavill Machine Co.
8	No. 131	Ramson dry grinding machines	Motch & Merrymaker Mchy. Co.
1		Grinding machine	Wm. Sellars & Co., Inc.
1		Saw blade redressing machine	J. T. Ryerson & Sons
1	6-in. by 6-in.	Peerless metal saw	Manning, Maxwell & Moore
1	Type BH	Portable rail saw	The Aldon Co.
1	No. 2	Underwood cyl., dome facing mach.	Storer Machinery Co.
1	No. 3	Underwood loco. dome facing mach.	Storer Machinery Co.
1	No. 4	Underwood portable cyl. facer	Storer Machinery Co.
1	3½-in. by 6-ft.	Underwood loco. cyl. boring bar	Storer Machinery Co.
1	3½-in. by 6-ft.	Locomotive boring bar	Manning, Maxwell & Moore
1	4-in. by 6-ft.	Locomotive boring bar	Manning, Maxwell & Moore
1	No. 4	Nicholson arbor press	L. A. Benson Co.
1	No. 3	Foot power mitering machine	J. A. Fay & Egan Co.
1	No. 321	Hand power mitering machine	J. A. Fay & Egan Co.
1	18-in.	Hand planing and jointing mach.	J. A. Fay & Egan Co.
2	36½-in. by 21½-in. by 27-in.	Air compressors	Ingersoll-Rand Co.
2		Painting equipments	W. N. Matthews Corp.
3	12-in.	Belt lacers	Peerless Belt Lacing Machine Co.

Bangor & Aroostook

1	No. 2	Crank pin turner	Manning, Maxwell & Moore
1	4½-in. by 6-ft.	Locomotive boring bar	H. B. Underwood Corp.
1	Type B	Blacksmith hammer	Blacker Engineering Co.
1	14-in.	Draft saw	American Wood Working Machine Co.
2	3T	Triple test racks	Westinghouse Air Brake Co.

Boston & Albany

1	45-in.	Axle journal truing lathe	Consolidated Machine Tool Corp.
2	18-in.	Engine lathes	The Bradford Machine Tool Co.
1	20-in.	Engine lathe	Boye & Emmes
1	24-in.	Engine lathe	Reed-Prentice Co.
1	No. 4	Turret lathe	Warner & Swasey Co.
1	6-ft.	Radial drill	Niles-Bement-Pond Co.
1		Single Spindle loco. rod boring machine	Baker Brothers
2	36-in. by 36-in. by 12-ft.	Planers	Niles-Bemnet-Pond Co.
1	32-in.	Shaper	Cincinnati Shaper Co.
1	50-in.	Horizontal milling machine	Cincinnati Milling Machine Co.
1	No. 51	Drill pointer	Oliver Instrument Co.
1	¼-in. by 2½-in.	Twist drill grinder	
1	8-in. by 8-in.	Metal cutting machine	E. C. Atkins Co.
1	1½-in. to 2½-in.	Double head bolt cutter	Niles-Bemnet-Pond Co.
1	1¼-in. to 6-in.	Pipe threading machine	Oster Manufacturing Co.
1	15-in.	Shear	Hilles & Jones
1	No. 2	Punch and shear	Long & Allstatter Co.
1	No. 2	Nibbling machine	Andrew C. Campbell Co.
1	¾-in.	Flanging machine	McCabe Manufacturing Co.
1	42-in.	Band saw	American Wood Working Mach. Co.
1	10-in. by 12-in.	Gaining machine	I. A. Fay & Egan Co.
1	4,000-lb.	Air hoist	Ingersoll-Rand Co.

No.	Size and capacity	Type of machine	Builder or dealer
1	4-spindle	Bolt turning machine	Walter H. Foster Co.
2	½-in. to 2½-in.	Bolt cutter	Acme Machine Tool Co.
1	No. 20	Punch and shear	Henry Pels & Co.
1	No. 2	Electric rivet heater	American Car & Foundry Co.
1	No. 3	Electric rivet heater	American Car & Foundry Co.
1	54-in.	Vertical band resaw	P. B. Yates Machine Co.
1	5-in.	Finishing surfacer	P. B. Yates Machine Co.
1	3,000-lb.	Crane	Automatic Transportation Co.
11	4,000-lb.	Electric trucks	Baker, R. & L. Co.
1	No. 3	Air brake test rack	New York Air Brake Co.
1	23-in.	Air compressor	Hardie-Tynes Manufacturing Co.
1	1,200 r.p.m.	Synchronous motor generator set	Westinghouse Electric & Mfg. Co.
1	200-amp.	Welding outfit	Westinghouse Electric & Mfg. Co.

Central Railroad of New Jersey

1	42-in.	Journal turning and axle lathe	Niles-Bemnet-Pond Co.
1	1¾-in.	Gridley screw machine	National Acme Co.
1	6-ft.	Radial drill	Niles-Bement-Pond Co.
1	42-in.	Car wheel turning lathe	Wm. Sellers & Co., Inc.
1	42-in.	Car wheel borer	Niles-Bement-Pond Co.
1	100-in.	Vertical boring mill	Wm. Sellers & Co., Inc.
1	84-in.	Grinding machine	Diamond Machine Tool Co.
2	Type F. K.	Bench grinders	Keller Mechanical Eng. Corp.
1	6-in.	Saw	Van Dyke Churchill Co.
1	1½-in.	Bolt threading machine	Acme Machine Tool Co.
1	1,250-lb.	Steam hammer	Chambersburg Engineering Co.
1	100-ft.	Turntable tractor	R. W. Young Co.
3	1,000-lb.	Air-motor hoists	Ingersoll-Rand Co.
1	2,000-lb.	Air-motor hoist	Ingersoll-Rand Co.
4	2-ton	Chain hoists	Wright Manufacturing Co.
1	3-ton	Chain hoist	Reading Chain Hoist Co.
1	WDIO-A	Arc welding outfit	General Electric Co.

Chesapeake & Ohio

1	45-in.	Betts Journal truing and axle lathe	Consolidated Mach. Tool Corp.
1	15-in. by 8-ft.	Engine lathe	R. K. LeBlond Machine Tool Co.
1	16-in. by 9-ft.	Engine lathe	Lehmann Machine Co.
1	90-in.	Wheel lathe	Wm. Sellers & Co., Inc.
1	5-ft.	Radial drill	American Tool Works
4	6-ft.	Radial drills	American Tool Works
1	13-ft.	Wall radial drill	Lynd-Farquhar Co.
1	32-in. by 32-in. by 40-in.	Newton crank planer	Consolidated Mach. Tool Corp.
1	36-in.	Shaper	Morton Manufacturing Co.
1	18-in.	Betts Crank slotter	Consolidated Mach. Tool Corp.
1	52-in.	Betts Boring mill	Consolidated Mach. Tool Corp.
1	60-in.	Horizontal boring machine	Lucas Machine Tool Co.
3	18-in.	Grinders	Hisey-Wolf Machine Tool Co.
1	36-in. by 4-in. by 21-in.	Wet tool grinder	Diamond Machine Tool Co.
1	2¾-in.	Drill pointer	Oliver Instrument Co.
1	13-in. by 16-in.	Hack saw	Peerless Machine Co.
1	1-in. to 4-in.	Pipe threader	Oster Manufacturing Co.
1		Portable cylinder facer	E. J. Rocksby & Co.
1	30-in.	Flaning machine	H. B. Underwood Corp.
1		Horizontal staybolt machine	Gisholt Machine Co.
1	100-ton	Bushing press	Chambersburg Engineering Co.
1	48-in.	Car wheel press	Chambersburg Engineering Co
1	600-lb.	Steam hammer	Niles-Bement-Pond Co.
1	96-in.	Shear	Niagara Machine & Tool Works
1	48-in.	Shear	Henry Pels & Co.
1		Punch and shear	Long & Alstatter Co.
1		Punch and shear	Niles-Bement-Pond Co.
1	12-ft.	Flanging clamp	Niles-Bement-Pond Co.
1	¾-in.	Pneumatic flanging machine	McCabe Manufacturing Co.
1	24-ft.	Hilles & Jones plate bending rolls	Consolidated Mach. Tool Corp.
1	12-in.	Pneumatic mud-ring riveter	Hanna Engineering Works
1	15-in. to 18-in.	Pneumatic tank riveter	Hanna Engineering Works
1		Blower	Buffalo Forge Co.
1	12-in. by 18-in. by 4-ft.	Furnace	Ferguson Furnace Co.
1	200-ton	Locomotive hoist	Whiting Corp.
1	2,600-cu. ft.	Air compressor	Chicago Pneumatic Tool Co.
1	7-in. by 6-in.	Air compressor	Ingersoll-Rand Co.

Chicago, Burlington & Quincy

1	38-in.	Axle lathe	
3	55-in.	Journal and truing lathe	
1		Double end axle lathe	
2	16-in.	Engine lathes	
1	18-in.	Engine lathe	
1	1½-in.	Upright drill	

Chicago, Burlington & Quincy (Continued)

No.	Size and capacity	Type of machine	Builder or dealer
1	3-in.	Upright drill	
1	4-in.	Upright drill	
4	20-in.	Upright drill presses	
1	¾-in.	Double Spindle drill	
1	32-in. stroke	Crank shaper	
2		Car wheel borers	
1	No. 2	Internal radius grinder	
1		Internal grinder	
1	10-in.	Pedestal grinder	
2	20-in.	Dry pedestal grinders	
1	24-in. by 3-in.	Wet tool grinder	
1	No. 50	Disc grinder	
1	6-spindle	Angle cock grinder	
1	24-in.	Automatic cut-off machine	
1	36-in.	Automatic cut-off machine	
1		Portable cut-off saw	
1	6-in. by 6-in.	Metal cutting machine	
1	3½-in.	Boring bar	
1	4½-in.	Boring bar	
1	6-in.	Boring bar	
1	400-ton	Wheel press	
1	200-lb.	Helve hammer	
1	No. A	Bulldozer	
1	2-in.	Forging machine	
1	2¼-in. stroke	Multiple punch	
1	30-in.	Knife shear	
1	10-gage	Serpentine shear	
1	No. 14	Punch and spacing table	
1	¾-in. plate	Flanging machine	
1	4-sided	Planer and matcher	
1	No. 502	Car gainer	
1	24-in.	Rip saw	
6	12½-in. by 18½-in.	Jolt and strippers	
1	Size D	Hand bending machine	
1		Triple valve test rack	

Chicago & Eastern Illinois

1		Journal turning and axle lathe	Niles-Bement-Pond Co.

Chicago, Indianapolis & Louisville

1		Castillo electric wheel grinder	
1	½-in. to 2-in.	Bolt threading machine	Landis Machine Co.

Chicago, Milwaukee & St. Paul

1	90-in.	Journal turning and quart'r'g mach.	
1		Journal truing lathe	
1	16-in. by 8-ft.	Toolroom lathe	American Tool Works
1	18-in. by 8-ft.	Engine lathe	Lodge & Shipley Machine Tool Co.
1	18-in. by 12-ft.	Engine lathe	
3	24-in. by 12-ft.	Engine lathes	
1	36-in. by 18-ft.	Engine lathe	
1	16-in.	Toolroom lathe	
1	2-in.	Turret lathe	Jones & Lamson Machine Co.
1	90-in.	Wheel lathe	Wm. Sellers & Co., Inc.
1	90-in.	Wheel lathe	
1	¾-in. by 29-in.	Turret lathe	
1	7½-in.	Turret lathe	Gisholt Machine Co.
1	No. 36B	Automatic gear cutter	Gould & Eberhardt
1	3-ft.	Radial drill	Cincinnati Bickford Tool Co.
1	4-ft.	Radial drill	Fosdick Machine Tool Co.
1	54-in.	Radial drill	
2	6-ft.	Radial drill	Dresses Machine Tool Co.
2	6-ft.	Radial drill	Reed-Prentice Co.
1	20-in.	Upright drill	W. F. & J. Barnes Co.
1	21-in.	Upright drill press	
1	36-in.	Upright drill	
1	42-in.	Snyder Upright drill	W. F. & J. Barnes Co.
1	¾-in.	Sensitive drill	
1	32-in.	Crank planer	Newton Machine Tool Co.
1	10-in.	Vertical shaper	
1	28-in.	Shaper	
1	32-in.	Crank shaper	
2	36-in.	Draw cut shapers	Morton Manufacturing Co.
2	42-in.	Vertical turret lathes	Bullard Machine Tool Co.
1	44-in.	Boring mill	

No.	Size and capacity	Type of machine	Builder or dealer
1	30-in. by 24-in. by 10-ft.	Planer type miller	Ingersoll Milling Machine Co.
1	28-in.	Car wheel borer	Niles-Bement-Pond Co.
1	No. 3	Horizontal miller	Rockford Machine Tool Co.
1	No. 4	Horizontal miller	Cincinnati Milling Machine Co.
1		Air pump grinder	Micro Machine Co.
2		Link grinders	Gisholt Machine Co.
2	3-in. by 18-in.	Double dry grinders	U. S. Electrical Tool Co.
1	12-in. by 2-in.	Double dry grinder	U. S. Electrical Tool Co.
1	24-in. by 4-in.	Double dry grinder	U. S. Electrical Tool Co.
1		Buffing machine	U. S. Electrical Tool Co.
1	No. 18-ESB	Power hack saw	E. C. Atkins & Co.
2		Cylinder facing machines	H. B. Underwood Corp.
2	4-in. by 6-ft.	Valve boring bars	E. J. Rooksby & Co.
1	3-in.	Single head bolt cutter	Landis Machine Co.
1	No. 6	Pipe threading machine	Bingal & Keeler Co.
1	800-ton	Wheel press	Southwark Foundry & Machine Co.
1	⅜-in. by 36-in.	Nibbling machine	W. J. Savage Co.
1	24-in.	Rip saw	J. A. Fay & Egan Co.
2	10-ton	Traveling cranes	Shaw Crane Co.
1	1-ton	Electric hoist	Box Crane Co.
1	3T	Test rack	New York Air Brake Co.
2	12-in. by 10-in.	Air compressors	Chicago Pneumatic Tool Co.
1		Electric welder	Westinghouse Electric & Mfg. Co.
1		Electric welder	General Electric Co.
1	No. 444	Electric spot welder	Federal Welding Co.

Clinchfield Railroad

1	4,500-lb.	Single frame steam hammer	Chambersburg Engineering Co.
1	No. 2	Spring forming machine	Jos. T. Ryerson & Son
2	250-lb.	Single frame steam hammers	Chambersburg Engineering Co.
1	1½-in. wedge grip	Forging machine	Buffalo Forge Co.
1	Size E	Punch	Hilles & Jones Co.
14	No. 86-D	Forges	Buffalo Forge Co.
8	No. 504	Oil-burning rivet forges	Hauck Manufacturing Co.
4		Oil furnaces	DeRemer-Blatchford Co.
1	No. 3½	Exhaust fan	Buffalo Forge Co.
1	No. 5	Exhaust fan	Buffalo Forge Co.
1	No. 379B	Mortiser	J. A. Fay & Egan Co.
1	24-in. by 7-in.	Single cylinder surfacer	J. A. Fay & Egan Co.
1	No. 505	Tenoning machine	J. A. Fay & Egan Co.
1	No. 108	Band rip saw	J. A. Fay & Egan Co.
1	6-in.	Molding machine	J. A. Fay & Egan Co.
1	No. 452F	Double spindle shaper	J. A. Fay & Egan Co.
1	No. 453	Belt sander	J. A. Fay & Egan Co.
1	1½-ton	Electric tractor crane	Baker R. & L. Co.
1	Type DTQ	Electric tractor	Baker R. & L. Co.
4	5-wheel type	Trailers for electric tractor	V. M. Cooper & Co.
1	20-in. by 12-in. by 18-in.	Compressor	Hardie-Tynes Mfg. Co.
1	25-in. by 15½-ft. by 20-in.	Compressor	Hardie-Tynes Mfg. Co.

Colorado & Southern

2	200-amp.	Electric welding machines	Westinghouse Electric & Mfg. Co.

Dansville & Mount Morris

1	16-in.	Lathe	Davis Metal Tool Co.
1	26-in.	Upright drill press	American Glyco Metal Co.

Delaware & Hudson

1	42-in.	Journal truing and axle lathe	Niles-Bement-Pond Co.
1		Drill press	Simmons Machine Tool Co.
1	39½-in.	Crank planer	Newton Machine Tool Works
1	54-in. by 34-in. by 18-ft.	Planer	Wm. Sellers & Co., Inc.
1	No. 136	Ransom grinding machine	Niles-Bement-Pond Co.
1		Swing frame grinder	L. Best & Co.
1	No. 9	Racine hack saw	Manning, Maxwell & Moore
2	Nos. 1 and 2	Underwood air pump boring bars	Manning, Maxwell & Moore
1	4-in. by 6-ft.	Underwood boring bar	Manning, Maxwell & Moore
1	48-in., 500-ton	Car wheel press	Niles-Bement-Pond Co.
1	36-in.	Cut-off saw	Greenlee Bros. & Co.
1	No. 500	Variety saw	J. A. Fay & Egan Co.
1	P-16	Timber sizer, planer and matcher	P. B. Yates Machine Co.
1	300 cu. ft.	Air compressor	Ingersoll-Rand Co.
1	450-cu. ft.	Air compressor	Ingersoll-Rand Co.
1	2,000 cu. ft.	Air compressor	Ingersoll-Rand Co.

No.	Size and capacity	Type of machine	Builder or dealer
1	12-in. by 36-in.	Universal grinder	
1	1½-in.	Universal cutter and reamer grinder	
1	No. 1	Tool grinding and shaping machine.	Wm. Sellers & Co., Inc.
1	12-in. wheel	Electric floor grinder	
2	18-in. wheel	Electric grinders	
2	24-in. wheel	Electric floor grinders	
1	No. 3	Hack saw	Racine Tool & Machine Co.
1	No. 4	Hack saw	Armstrong-Blum Mfg. Co.
1	2-in.	Triple head bolt cutter	
1	1,100-lb.	Steam hammer	Chambersburg Engineering Co.
1	3,300-lb.	Steam hammer	Chambersburg Engineering Co.
1	600-ton	Wheel press	Chambersburg Engineering Co.
1	No. 5	Punch press	Rockford Tool Co.
1	8 ft.	Squaring shear	
2	48-in.	Single punch and shear	Hilles & Jones Co.
3	48-in.	Double punch and shear	Hilles & Jones Co.
1	72-in.	Edging machine	Dries & Krump Mfg. Co.
1	10-ft.	Power brake	
1	¾-in.	Flanger	McCabe Manufacturing Co.
1	14-ft.	Vertical bending roll	
3		Gas furnaces	
1		Oil tempering furnace	
1	7½-ton	Jib crane	Whiting Corp.
1	3,000-lb.	Electric truck	Baker R. & L. Co.
1		Gasoline tractor	Ford Motor Co.
1		Motor	Westinghouse Electrical Mfg. Co.
4	300-amp.	Electric welders	
7		Electric welders	

Chicago, River & Indiana

1	No. 4 E. R.	Cutter and tool grinder	Gallmeyer & Livingston Co.
1	No. 10-C	Motor-driven saw	Racine Tool & Machine Co.
1	3,000-lb.	Electric truck	Baker R. & L. Co.
1		Cutler-Hammer battery charger	Baker R. & L. Co.

Chicago, Rock Island & Pacific

1	No. 3	Axle lathe	Niles-Bement-Pond Co.
1	16-in. by 8-ft.	Engine lathe	E. L. Essley Machinery Co.
1	18-in. by 10-ft.	Morris engine lathe	Niles-Bement-Pond Co.
2	90-in.	Quartering and boring machine	Niles-Bement-Pond Co.
1	24-in. by 36-in.	Upright drill press	Marshall & Huschart Machinery Co.
1		Single spindle drilling machine	Marshall & Huschart Machinery Co.
1	2-in. diameter	Mud ring drill	Niles-Bement-Pond Co.
1	48-in. by 48-in. by 14-ft.	Planer	Niles-Bement-Pond Co.
1	100-in.	Boring and turning mill	Niles-Bement-Pond Co.
1	Model G	Internal grinder	Manning, Maxwell & Moore.
7	No. 131	Motor-driven grinders	Ransom Manufacturing Co.
1		Car wheel grinder	
1	3¼-in. by 6-ft.	Valve chamber boring bar	Niles-Bement-Pond Co.
1	4½-in. by 8-ft.	Cylinder boring bar	Niles-Bement-Pond Co.
1	2-in.	Landis triple head staybolt threader.	Hendrie & Bolthoff Mfg. & Supply Co.
1	No. 1	Horizontal punch	Niles-Bement-Pond Co.
1	No. 27	Slitting shear, punch and bar cutter.	Buffalo Forge Co.
4	60-ton	Driving box and rod bush presses.	Watson-Stillman Co.
1	¾-in. plate capacity	Flanging press	McCabe Manufacturing Co.
8		Fordson tractors	G. T. O'Mahy, Inc.
1		Industrial tractor	International Harvester Co.
3	300-amp.	Welder	U. S. Light & Heat Corp.

Cincinnati Northern

1	18-in.	Slotter	Dill Machine Co.
1	1½-in.	Staybolt threader	Acme Machinery Co.

Cleveland, Cincinnati, Chicago & St. Louis

4	11-in. by 4-ft.	Engine lathes	R. K. LeBlond Machine Tool Co.
1	6-ft.	Engine lathe	R. K. LeBlond Machine Tool Co.
1	36-in.	Engine lathe	Niles-Bement-Pond Co.
1	3¼-in.	Turret lathe	Acme Machine Tool Co.
1	24-in.	Turret lathe	Steinle Turret Machine Co.
1	4¼-in. by 8-in. to 6-in. by 11-in.	Journal bearing broach	Ar-an-Ess Co.
3	5-ft.	Radial drills	American Tool Works
1	6-ft.	Radial drill	Niles-Bement-Pond Co.
1	24-in.	Vertical drill	Aurora Machine Tool Co.
1		Four-spindle drill	Foote-Burt Co.

Delaware, Lackawanna & Western

No.	Size and capacity	Type of machine	Builder or dealer
1	90-in.	Journal turning lathe	Manning, Maxwell & Moore
1	11-in. by 5-ft.	Leblond lathe	Niles-Bement-Pond Co.
1	11-in. by 5-ft.	Engine lathe	Niles-Bement-Pond Co.
1	2¼-in. by 24-in.	Turret lathe	Jones & Lamson Machine Co.
1	No. 2	Turret lathe	W. E. Shipley Machinery Co.
1	28-in.	Engine lathe	
1	5-ft.	Dresses radial drill	Manning, Maxwell & Moore
1	6-ft.	Radial drill	Niles-Bement-Pond Co.
2	No. 2	Sensitive drills	H. Prentiss & Co.
1	60-in. by 60-in. by 12-ft.	Metal planer	Niles-Bement-Pond Co.
1	32-in.	Columbia crank shaper	Manning, Maxwell & Moore
1	32-in.	Crank shaper	
1	32-in.	Climax shaper	Swind Machinery Co.
1	36-in.	Railroad draw-cut shaper	Morton Manufacturing Co.
1	42-in.	Vertical turret lathe	Bullard Machine Tool Co.
1	62-in.	Horizontal boring and drill mach.	Niles-Bement-Pond Co.
1	84-in.	Boring and turning mill	Niles-Bement-Pond Co.
1	16-in. by 40-in. by 120-in.	Piston rod grinder	Norton Co.
1	86-in.	Face grinder	Bridgeport Safety Emery Whl.Co.
1	No. 2-1	Universal grinding machine	Brown & Sharpe Co.
1	No. 13	Universal and tool grinding mach.	Brown & Sharpe Co.
1	No. 6	Bridgeport floor grinder	Manning, Maxwell & Moore
1	No. 2	Drill grinding machine	William Sellers & Co., Inc.
1		Twist drill grinder	
1	5-in. by 7-in.	Boring bar	E. J. Rooksby & Co.
1	25-in. to 30-in.	Cylinder joint facing machine	H. B. Underwood Corp.
1	26-in.	Rotary planer	E. J. Rooksby & Co.
1		Crank pin turning machine	H. B. Underwood Corp.
1	4-in.	Pipe cutting and threading mach.	Landis Machine Co.
1		Blacksmith hammer	Blacker Engineering Co., Inc.
2	50-ton	Forcing, bush., and bend. presses.	Manning, Maxwell & Moore
1	4-in.	Heading, upsetting and forg. mach.	Ajax Manufacturing Co.
1	No. 16 gage	Power shear	Manning, Maxwell & Moore
1	1½-in. to 6½-in.	Flue welding machine	Jos. T. Ryerson & Son
1	2-in. to 6½-in.	Saw and tube expanding machine.	Jos. T. Ryerson & Son
1	6-in.	Flue welding furnace	Jos. T. Ryerson & Son
1	No. 10 gage	Power brake	D. Nash Mchy. Co.
1	48-in.	Yoke riveter	Hanna Engineering Works
4		Rivet heating forges	Mahr Manufacturing Co.
4		Rivet forges	Hauck Manufacturing Co.
2	4-ft. by 14-ft. by 2-ft.	Annealing furnaces	Mahr Manufacturing Co.
1	1,000-lb.	Tilting and melting furnace	W. S. Rockwell Co.
1		Electric furnace	Hoskins Manufacturing Co.
1	20-in.	Band saw	R. L. Barker & Co.
1	No. 2	Rip saw	J. A. Fay & Egan Co.
1	No. 30	Universal saw bench	American Woodworking Mach. Co.
1		Universal saw	R. L. Barker & Co.
1	8-in.	Jointer	R. L. Barker & Co.
1	2-spindle	Freizing and shaping machine	J. A. Fay & Egan Co.
1		Drop pit table	Whiting Corp.
3		Elevating platform trucks	Elwell-Parker Electric Co.
1		Electric crane truck	Elwell-Parker Electric Co.
2		Electric trucks	Elwell-Parker Electric Co.
2	DYAQ	Loco. crane trucks	Baker R & L Co.
1		3-T Triple valve test rack	Westinghouse Air Brake Co.
1		Motor generator set	Electric Products Co.
1		Generator set	Hertner Electric Co.
1	200-amp.	Arc welding machine	Westinghouse Elec. & Mfg. Co.
1	300-amp.	Arc welding machine	Lincoln Electric Co.
1	Size "A"	Blue printing machine	C. F. Pease Co.

Duluth, Massabe & Northern

1	2¼-in. by 26-in.	Turret lathe	Greenlee Bros. & Co.
1	No. 475	Tool grinder	Mummert-Dixon Co.
2	2-wheel	Electric bench grinders	U. S. Electrical Tool Co.
1	¼-in. to 2-in.	Pipe threader	Oster Manufacturing Co.
7	3 Electrode	Electric rivet heaters	American Car & Foundry Co.
1	No. 88	Oil babbitt furnace	Mahr Manufacturing Co.
9		Forges	Buffalo Forge Co.
1	2,000-lb.	Air hoist	Ingersoll-Rand Co.
1	2,000-lb.	Electric hoist	American Engineering Co.
1	6,000-lb.	Elevating truck	Baker R. & L. Co.
1	No. 6	Oil renovator	Sharples Specialty Co.

Elgin, Joilet & Eastern

1	24-in.	Barnes upright drill	E. L. Essley Machinery Co.
2	No. 131	Grinders	Ransom Manufacturing Co.
1	300-ton	Forging press	Manning, Maxwell & Moore
1	1,000-lb.	Steam hammer	Manning, Maxwell & Moore

Elgin, Joliet & Eastern (Continued)

No.	Size and capacity	Type of machine	Builder or dealer
1	.....	Pattern maker's lathe	J. A. Fay & Egan Co.
2	No. 351A	Post borers	Greenlee Bros. & Co.
1	36-in.	Wood band saw	J. A. Fay & Egan Co.
1	No. 223	Cut-off saw	J. A. Fay & Egan Co.
2	6-ton	Electric traveling cranes	Milwaukee Elec. Crane & Mfg.Co.
2	.....	Triple valve test racks	Westinghouse Air Brake Co.
1	20-in. by 12-in. by 14-in.	Air compressor	Chicago Pneumatic Tool Co.
3	100-k.v.a.	Transformers	Westinghouse Electric & Mfg. Co.
3	150-k.v.a.	Transformers	Westinghouse Electric & Mfg. Co.
1	2-unit	Electric welding machine	General Electric Co.
1	.....	Electric welding machine	Westinghouse Electric & Mfg. Co.

Erie

1	No. 3	Axle lathe	Niles-Bement-Pond Co.
1	4L	Turret lathe	Gisholt Machine Co.
2	⅜-in.	Sensitive drill press	Allen Manufacturing Co.
1	B-W-1	Sensitive drill press	Sipp Machine Co.
2	No. 5	Twist drill grinder	Oliver Instrument Co.
1	24-in.	Metal cutting shaper	American Tool Works
1	26-in.	Metal cutting shaper	American Tool Works
2	48-in.	Car wheel borers	Niles-Bement-Pond Co.
2	No. 2	Band saw filing machines	Black Diamond Machine Co.
1	18-in. by 3-in.	Emery wheel stand	U. S. Electrical Tool Co.
1	BK-2	Die grinder	Kellar Engineering Corp.
1	4½-in. by 8-ft.	Loco. cyl. boring bar	H. B. Underwood Corp.
1	304-B	Pipe threading machine	Oster Manufacturing Co.
3	24-in. by 30-in.	Bushing presses	Chambersburg Engineering Co.
1	15-in.	Gap shear	Niagara Machine & Tool Works
3	8¾-in. by 10-in.	Compression riveters	Allen Manufacturing Co.
2	No. 45	Exhaust fans	B. F. Sturtevant Co.
24	No. 18	Rivet forges	Mahr Manufacturing Co.
1	No. 7	Oven type furnace	Chicago Flexible Shaft Co.
1	4-ft. by 6-ft. by 1½-ft. pot	Spring temp. furn. & blower equip	Mahr Manufacturing Co.
1	¾-in.	Motor driven mortiser	Greenlee Brothers & Co.
1	No. 226	Hollow chisel mortiser	Greenlee Brothers & Co.
1	No. 2	Tenoning machine	J. A. Fay & Egan Co.
1	42-in.	Band saw	American Woodwk. Machine Co.
1	No. 60	Universal saw	Oliver Woodworking Mach. Co.
1	40-55-70	Dust and shavings collector	Kirk & Blum Manufacturing Co.
3	1-ton	Pneumatic motor hoists	Ingersoll-Rand Co.
1	2-ton	Elec. traveling hoist for gantry	Franklin Moore Co.
3	5-ton	Pneumatic motor hoists	Ingersoll-Rand Co.
1	10-ton	Electric jib crane	Whiting Corp.
1	3,000-lb.	Electric crane truck	Elwell-Parker Electric Co.
4	4,000-lb.	Hand elevating trucks	Plimpton Lift Truck Corp.
1	6,000-lb.	Electric elevating platform truck	Elwell-Parker Electric Co.
2	No. 3-T	Triple valve test rack	New York Air Brake Co.
1	52-cu. ft.	Motor driven air compressor	Westinghouse National Brake Co.
2	176-cu. ft.	Electric air compressor	Chicago Pneumatic Tool Co.
1	15 horsepower A. C.	Electric Motor	Westinghouse Electric & Mfg. Co.
1	75 horsepower 25 cycle	Electric Motor	Westinghouse Electric & Mfg. Co.
1	24-30-cell	Charging panel	Electric Products Co.
1	14-amp. 12-volt	Motor generator set	Westinghouse Electric & Mfg. Co.
2	Model G	Paint spray machines	Eclipse Air Brush Co.
1	No. 5-A	Paint burning machine	Mahr Manufacturing Co.
1	10-horsepower	Car puller	Mining Machine Co.
3	Type D. M.	Locomotive cleaning machines	"D & M" Cleaning Process Co.

Ft. Worth & Denver City

1	24-in.	Lehmann engine lathe	Dallee Machinery Co.
2	2½-in.	Daill presses	Barnes Machine Co.
1	32-in.	Shaper	Gould & Eberhardt
1	54-in.	Vertical turret lathe	Bullard Machine Tool Co.
2	No. 13	Dry grinders	Ransom Manufacturing Co.
1	¼-in. to 2½-in.	Bolt threader	Landis Machine Co.
1	2½-in.	Bolt threader	Landis Machine Co.
1	6-ft.	Bending rolls	Marshalltown Mfg. Co.
1	36-in.	Cut-off saw	Greenlee Brothers & Co.
3	.....	Welding machines	General Electric Co.

Fruit Growers' Express Co.

1	2-in.	Bolt threader	Landis Machine Co.
1	10-gage	Bending brake	Dreis & Krump Manufacturing Co.

Georgia, Florida & Alabama

1	10-horsepower	Electric arc welding machine	Bird-Potts Company, Inc.

No.	Size and capacity	Type of machine	Builder or dealer
1	4-ft.	Radial drill	American Tool Works
2	5-ft.	Radial drills	American Tool Works
1	5-ft.	Centering machine	Hendey Machine Co.
5	21-in.	Vertical drill press	Superior Machine Tool Co.
8	No. 263	Upright drills	W. F. & J. Barnes Co.
1	No. 53	Staybolt drill	The Taylor & Fenn Co.
1	20-in.	Crank shaper	Hendey Machine Co.
2	24-in.	Shapers	Ohio Machine Tool Co.
1	32-in.	Shaper	Ohio Machine Tool Co.
3	36-in.	Draw cut shapers	Morton Manufacturing Co.
1	20-in.	Slotting machine	Wm. Sellers & Co., Inc.
2	24-in.	Vertical turret lathes	Bullard Machine Tool Co.
1	36-in.	Vertical turret lathe	Bullard Machine Tool Co.
1	48-in.	Car wheel borer	Niles-Bement-Pond Co.
2	54-in.	Vertical turret lathes	Bullard Machine Tool Co.
2	100-in	Rail tire mills	Consolidated Machine Tool Corp.
1	No. 32	Horizontal boring and drilling mach.	Lucas Machine Tool Co.
1	.....	Boring and facing machine	Wm. Sellers & Co., Inc.
1	No. 4	Universal milling mach.	Cincinnati Milling Machine Co.
2	No. 5	Milling machines	Cincinnati Milling Machine Co.
3	No. 2	Sundstrand link and sur. grinders	Manning, Maxwell & Moore
7	No. 2	Sundstrand internal and sur. grind.	Rockford Milling Machine Co.
3	84-in.	Face grinders	Diamond Machine Co.
9	Type 7	Floor grinders	Hisey-Wolfe Machine Co.
5	5 hp.	Floor grinders	U. S. Electric Tool Co.
1	¼-in. by 2½-in.	Yankee twist drill grinder	Wilmarth-Marmon Co.
2	No. 5	Twist drill grinders	Oliver Instrument Co.
4	50-in.	Grinders	Wilmarth-Marmon Co.
5	.....	Die chaser grinders	Geometric Tool Co.
1	Type A.	Polishing and finishing machine	Production Machine Co.
3	6-in. by 6-in.	Power hack saws	Racine Tool & Machine Co.
2	.....	Crank pin turning machines	E. J. Rooksby & Co.
2	¾-in. by 1½-in.	Horizontal staybolt machines	Gisholdt Machine Co.
2	1½-in.	Bolt cutters	Acme Machine Co.
3	2-in.	Bolt cutters	Acme Machine Co.
1	2½-in.	Bolt cutter	Acme Machine Co.
3	No. 304-B.	Pipe threader and cutters	Oster Manufacturing Co.
1	96-in.	Driving wheel press	R. D. Wood & Co.
3	100-ton	Hydro-pneumatic forcing presses	Chambersburg Engineering Co.
2	No. 4	Arbor presses	Edwin E. Bartlett Co.
2	500-lb.	Helve hammers	C. C. Bradley & Son, Inc.
2	2,700-lb.	Steam hammers	Niles-Bement-Pond Co.
1	Type FV-42	Bar shear	Henry Pels & Co.
1	No. 37	Punch, shear and bar cutter	Buffalo Forge Co.
1	Type H. B. L. 10	Splitting and punching machine	Henry Pels & Co.
1	No. 50	Flue welder	Thompson Electric Welding Co.
1	No. 10-15	Flue welding furnace	DeRemer-Blatchford Co.
2	5¾-in.	Flue lathes	Marshalltown Manufacturing Co.
4	10-ft.	Pneumatic flanging clamps	Niles-Bement-Pond Co.
2	7-ft. 2-in.	Bending rolls	Cleveland Punch & Shear Wks. Co.
2	¾-in.	Pneumatic flanging machines	McCabe Manufacturing Co.
11	Type C-3-H.	Rivet heaters	R. C. S. Equipment Co.
2	1,000-lb.	Melting furnaces	U. S. Smelting Furnace Co.
2	3-ft. 5-in. by 6-ft. 6-in.	Hammer furnaces	DeRemer-Blatchford Co.
2	2-in.	Vertical car mortisers	Greenlee Brothers & Co.
1	30-in. by 8-in.	Surface machine	P. B. Yates Machine Co.
1	6-in.	Moulding machine	J. A. Fay & Egan Co.
1	10½-in.	Universal woodworker	J. A. Fay & Egan Co.
2	12-in.	Woodworkers	J. A. Fay & Egan Co.
1	21-in. by 13-in.	Rip saw	J. A. Fay & Egan Co.
1	No. 404, 30-in.	Rip saw bench	Greenlee Brothers & Co.
1	36-in.	Band saw	J. A. Fay & Egan Co.
1	42-in.	Band saw	American Wood Machine Co.
2	36-in.	Band saws	Hall & Brown Woodwk. Mach. Co.
1	No. 235	Cut-off saw	P. B. Yates Machine Co.
1	No. 262	Cut-off saw	J. A. Fay & Egan Co.
1	250-ton	Locomotive hoisting crane	Whiting Corp.
1	4,000-lb.	Air motor hoist	Ingersoll-Rand Co.
1	3,000-lb.	Crane truck	Auto Transportation Co.
2	Type DYAQ.	Crane trucks	Baker R. & L. Co.
6	300-amp.	Welding outfits	U. S. Light & Heat Corp.

Intermountain Railway

1	.....	Arc welder	General Electric Co.

Kansas City, Mexico & Orient

1	3,300-lb	Steam hammer	Chambersburg Engineering Co.
1	¾-in.	Flanger	McCabe Manufacturing Co.
1	No. G-36	Band saw	P. B. Yates Machine Co.
1	No. G-15	Tilting table	P. B. Yates Machine Co.

Georgia Railroad

No.	Size and capacity	Type of machine	Builder or dealer
1		Blast fan system	Mahr Manufacturing Co.

Great Northern

1	18-in. by 10-ft.	Engine lathe	Lodge & Shipley Mach. Tool Co.
1	No. 3	Universal turret lathe	Cincinnati Acme Tool Co.
1	44-in.	Driving box borer and facer	Bullard Machine Tool Co.
1		Car wheel borer	Wm. Sellers & Co., Inc.
1	600-ton	Driving wheel press	Watson-Stillman Co.
2	8-in. by 12-in. by 18-in.	Electric furnaces	Hoskins Manufacturing Co.
1	10-in. by 20-in. by 20-in.	Oil bath	Hoskins Manufacturing Co.

Gulf Coast Lines

1		Axle lathe	Putnam Machine Co.
1	16-in. by 8-ft.	Engine lathe	American Tool Works
1	20-in. by 10-ft.	Engine lathe	American Tool Works
1	24-in. by 12-ft.	Engine lathe	American Tool Works
1	30-in. by 14-ft.	Engine lathe	American Tool Works
1	4-ft.	Radial drill	American Tool Works
1	36-ft. by 36-ft. by 16-ft.	Metal planer	Woodward & Powell Mach. Co.
1	32-in.	Crank shaper	Columbia Machine Tool Co.
1	18-in.	Vertical slotter	Putnam Machine Co.
1	42-in.	Vertical turret lathe	Bullard Machine Tool Co.
1	No. 5A	Boring and milling machine	Defiance Machine Works
1	No. 1½	Universal grinder	Cincinnati Electric Tool Co.
1		Twist drill grinder	Grand Rapids Grinding Mach. Co.
1	2-in.	Triple head bolt cutter	Landis Machine Co.
1	6-in.	Pipe threader	Landis Machine Co.
1	100-ton	Crank pin press	Elmes Engineering Works
1	No. 20	Punch and shear	Henry Pels & Co.
1	5-ton	Traveling crane	Niles-Bement-Pond
1	15-ton	Traveling crane	Milwaukee Elec. Crane & Mfg. Co.

Gulf, Colorado & Santa Fe

1	No. 302-B	Pipe and nipple machine	Manning, Maxwell & Moore
1		Pneumatic flue swedging machine	Manning, Maxwell & Moore
1		Mahr Manufacturing Co.	Mahr Manufacturing Co.
2	½-ton	Air hoists	Pneumatic Tool Co.
1	1-ton	Air hoist	Chicago Pneumatic Tool Co.
1	1-ton	Geared air hoist	Independent Pneumatic Tool Co.
3		Geared trolleys	Higgins & Co.
1		Electric butt welding machine	Thompson Electric Welding Co.

Gulf, Mobile & Northern

1	21-in. by 12 ft.	Engine lathe	Jos. T. Ryerson & Son
1	450,000-lb.	Turntable tractor	George K. Nichols & Bros.
1	3,000-lb.	Crane truck	Elwell Parker Electric Co.
1	25-hp.	Slip ring lathe motor	General Electric Co.
1	300-amp.	Welding unit	Lincoln Electric Co.

Hocking Valley

1	175-cu. ft.	Horizontal air compressor	Chicago Pneumatic Tool Co.
1	2,200 cu. ft.	Duplex air compressor	Chicago Pneumatic Tool Co.

Illinois Central

1	90-in.	Locomotive axle journal lathe	Niles-Bement-Pond Co.
1	45-in.	Axle lathe	Betts-Bridgeford Machine Co.
3	11-in. by 6-ft.	Engine bolt lathes	Niles-Bement-Pond Co.
4	16-in. by 7-ft.	Engine lathes	Lehmann Machine Co.
1	16-in. by 10-ft.	Engine lathe	Lodge & Shipley Machine Tool Co.
1	20-in. by 10-ft.	Engine lathe	Boye & Emmes Machine Tool Co.
1	23-in. by 10-ft.	Engine lathe	Niles-Bement-Pond Co.
1	24-in. by 9-ft.	Engine lathe	Lehmann Machine Co.
4	24-in. by 10-ft.	Engine lathes	American Tool Works
1	30-in. by 18-ft.	Engine lathe	Niles-Bement-Pond Co.
2	30-in. by 18-ft.	Engine lathes	American Tool Works
1	36-in. by 18-ft.	Engine lathe	Niles-Bement-Pond Co.
1	12-in.	Engine lathe	Lodge & Shipley Machine Tool Co.
1	2¼-in. by 24-in.	Flat turret lathe	Jones & Lamson Machine Co.
1	3½-in. by 44-in.	Turret lathe	The Acme Machine Tool Co.
1	18-in.	All-geared turret lathe	Bardons & Oliver Machine Co.
2	90-in.	Driving wheel lathes	Niles-Bement-Pond Co.
1	90-in.	Wheel quartering machine	Niles-Bement-Pond Co.
3	No. 4	Tire turning lathes	Niles-Bement-Pond Co.

Kansas City Southern

No.	Size and capacity	Type of machine	Builder or dealer
1	400,000-lb.	Testing machine	Tinius-Olson Testing Machine Co.

Lake Superior & Ishpeming

1	No. 3	Electric rivet heater	American Car & Foundry Co.

Lehigh & New England

1	No. 20	Floor grinder	Cincinnati Electrical Tool Co.
1	C-3-H	Electric rivet furnace	American Car & Foundry Co.
1	200-amp.	Arc welding machine	Westinghouse Electric & Mfg. Co.

Lehigh Valley

1	18-in. by 10-ft.	Boye & Emmes engine lathe	Manning, Maxwell & Moore
1	24-in. by 14-ft.	Boye & Emmes engine lathe	Manning, Maxwell & Moore
1	36-in. by 42-in.	Woodward & Powell crank planer	Manning, Maxwell & Moore
1	4½-in.	Defiance boring and drilling mach.	Manning, Maxwell & Moore
1	42-in.	Bullard vertical turret lathe	W. E. Shipley Machinery Co.
1	4¾-in.	Surface grinding machine	Brown & Sharpe Co.
1	No. 6.	Blount floor grinder	Manning, Maxwell & Moore
1	¼-in. to 2-in.	Oster pipe threader	Manning, Maxwell & Moore
1	1¼-in. to 6-in.	Oster pipe threader and cutter	Manning, Maxwell & Moore
1	5-ton.	Little Giant air hoist	Chicago Pneumatic Tool Co.
1	Type CK.	Electric crane truck	Elwell-Parker Electric Co.
1		Universal valve test rack	Westinghouse Air Brake Co.
1	40-hp.	Electric motor	Westinghouse Electric & Mfg. Co.
1	Single unit	Automatic charging plant	Electric Products Co.

Long Island

1	42-in.	Car wheel lathe	Wm. Sellers & Co., Inc.
1	⅝-in. by 7-in. by 72-in.	Elliptic spring former	Jos. T. Ryerson & Son
4	20-ton	Overhead cranes	Whiting Corp.
1	3,000-lb.	Electric crane truck	Elwell-Parker Electric Co.
1		Generator set for electro plating	A. P. Munning Co.

Los Angeles & Salt Lake

2	18-in. by 8-ft.	Engine lathes	Monarch Machine Tool Co.
1	20-in. by 10-ft.	Engine lathe	Monarch Machine Tool Co.
1	20-in.	Brass lathe	Dresses Machine Tool Co.
1	5-ft.	Radial drill	Western Machine Tool Works
1		Drawcut shaper	Morton Manufacturing Co.
1	2-wheel	Ball bearing grinder	U. S. Electrical Tool Co.
1	18-in. to 30-in. diameter	Facing machine	H. B. Underwood Corp.
2	1½-in.	Triple head bolt machines	Landis Machine Co.
1		Pneumatic tube welding machine	Draper Manufacturing Co.
1	¾-in. plate	Flanging machine	McCabe Manufacturing Co.
1	9-ft. 6-in. by 12-ft.	Plate furnace	DeRemer-Blatchford Co.
1	Type X-2	Air compressor	Ingersoll-Rand Co.
1	15-hp.	Ball bearing motor	U. S. Electrical Manufacturing Co.
1	20-hp.	Ball bearing motor	U. S. Electrical Manufacturing Co.
1	25-hp.	Ball bearing motor	U. S. Electrical Manufacturing Co.
1	Type WD-9	Electric welding generator set	General Electric Co.
5	WD-12	Electric welding generator sets	General Electric Co.

Louisville, Henderson & St. Louis

1	WD-9	Arc welder	General Electric Co.

Louisville & Nashville

2	16-in. by 8-ft.	Engine lathe	Manning, Maxwell & Moore
2	18-in. by 8-ft.	Engine lathes	New York Shipbuilding Corp.
1	18-in. by 8-ft.	Engine lathe	Brownell Machinery Co.
1	24-in. by 12-ft.	Engine lathe	A. C. Love & Co.
1	26-in. to 42-in.	Car wheel lathe	Niles-Bement-Pond Co.
1	27-in. by 12-ft.	Engine lathe	A. C. Love & Co.
5	36-in. by 17-ft.	Engine lathe	Niles Bement-Pond Co.
2	3-in. by 36-in. by 15-in.	Turret lathes	Jones & Lamson Machine Co.
1	90-in.	Driving wheel lathe	Manning, Maxwell & Moore
1	20-in.	Lead drill	Niles-Bement-Pond Co.
1	36-in. by 36-in. by 8-ft.	Planer	E. A. Kinsey Co.
1	36-in. by 36-in. by 12-ft.	Planer	Manning, Maxwell & Moore
1	38-in.	Spiral geared planer	E. A. Kinsey Co.
1	32-in.	Shaper	Ohio Machine Tool Co.
1		Milling machine	Vonnegut Machinery Co.

Louisville & Nashville (Continued)

No.	Size and capacity	Type of machine	Builder or dealer
1	.....	Gisholt internal grinder	E. A. Kinsey Co.
1	3-hp.	Light tool grinder	Manning, Maxwell & Moore
2	7¾-in. and 6¼-in.	Tool grinders	E. A. Kinsey Co.
1	8-in. by 24-in.	Tool grinder	E. A. Kinsey Co.
2	6-in. by 6-in.	Hack saw machine	Doermann-Roehrer Co.
1	10-in. and 11½-in.	Crank pin turning machine	Walraven Co.
1	2-in.	Double-head bolt cutter	Manning, Maxwell & Moore
2	100-ton	Bushing presses	Manning, Maxwell & Moore
2	100-ton	Bushing presses	Niles Tool Works
1	400-ton	Wheel press	Manning, Maxwell & Moore
2	600-ton	Wheel presses	Manning, Maxwell & Moore
1	1,100-lb.	Steam hammer	New York Shipbuilding Corp.
2	2-in.	Bolt heading and forging machines	Ajax Manufacturing Co.
3	1½-in. to 6½-in.	Flue welding machines	Jos. T. Ryerson & Son
2	No. 6-E.	Electric forge blowers	Buffalo Forge Co.
1	200-ton	Locomotive hoist	Whiting Corp.
1	30-ton	Drop pit jack	Watson-Stillman Co.
1	100-ton	Tractor	Ford Motor Co.
1	12-in. by 17-in. by 10-in. by 14-in.	Air compressor	Bury Compressor Co.
2	175-amp.	Arc welding sets	Westinghouse Electric & Mfg. Co.
7	200-amp.	Arc welding sets	Westinghouse Electric & Mfg. Co.

Minneapolis & St. Louis

1	36-in.	Draw-cut Shaper	Morton Manufacturing Co.

Michigan Central

1	.....	Double end axle lathe	Canadian Machinery Corp.
1	24-in. by 12-ft.	Engine lathe	Monarch Machine Tool Co.
1	17-in.	Engine lathe	R. K. LeBlond Machine Tool Co.
1	19-in.	Engine lathe	R. K. LeBlond Machine Tool Co.
1	24-in.	Engine lathe	R. K. LeBlond Machine Tool Co.
1	42-in.	Wheel turning lathe	John Bertram & Sons
1	90-in.	Putnam driving wheel lathe	Manning, Maxwell & Moore
1	5-ft.	Radial drill	American Tool Works
1	6-ft.	Radial drill	American Tool Works
2	20-in.	Upright drills	Bickford Tool Co.
1	25-in.	Upright drill	Superior Machine Tool Co.
1	16-in.	Shaper	Ohio Machine & Tool Co.
1	52-in.	Betts wheel boring machine	Consolidated Machine Tool Co.
1	100-in.	Betts tire mill	Consolidated Machine Tool Co.
3	.....	Twist drill grinders	Oliver Instrument Co.
1	.....	Cutter grinder	Landis Machine Co.
1	6-in.	Grinder	Van Dorn Electric Tool Co.
1	No. 156	Dry grinder	Forbes & Meyers Co.
3	.....	Dry grinders	Forbes & Meyers Co.
2	.....	Grinders	Forbes & Meyers Co.
1	No. 1	Circular saw sharpener	Samuel C. Rogers Co.
1	.....	Band saw filer	Samuel C. Rogers Co.
1	.....	Metal band saw	Stockridge Machine Co.
2	2-in.	Pipe cutting machines	Oster Manufacturing Co.
1	4-in.	Pipe machine	Oster Manufacturing Co.
1	No. 2	Hammer	Nazel Engineering Co.
1	No. 4	Hammer	Nazel Engineering Co.
1	"B"	Forging hammer	Blacker Engineering Co.
1	16-in. by 70-in.	Bulldozer	Williams, White & Co.
1	No. 2	Eye bolt machine	Williams White Co.
1	No. 2	Scrap cutting machine	Doelger & Kristen
1	No. 3	Scrap cutting machine	Doelger & Kristen
1	20-in.	Punch	Buffalo Forge Co.
1	.....	Punching machine	Thomas Spacing Machine Co.
1	.....	Ring and circle shear	Peck, Stow & Wilcox Co.
1	.....	Splitting shear	Buffalo Forge Co.
1	¼-in. by 10-in.	Bending roll	Wicks Brothers
1	10-ft.	Power brake	Dries & Krump
1	.....	Adjusting machine	Walter Stock Co.
1	.....	Blower fan	Clarage Fan Co.
1	.....	Blower fans	Buffalo Forge Co.
2	.....	Annealing furnace	DeRemer-Blatchford Co.
1	6-ft. by 16-ft. by 6-in.	Tenoning machine	Amer. Wood Working Mach. Co.
1	No. 1	Bench universal saw	T. D. Wallace Co.
1	7-in.	Poney wood planer	Baxter E. Whitney & Son
1	No. 22	Fordson tractors	Ford Motor Co.
3	.....	Tructractor	Clark Tractor Co.
1	.....	Air compressor	Chicago Pneumatic Tool Co.
1	1,000-cu. ft.	Air compressor	Chicago Pneumatic Tool Co.
1	1,574-cu. ft.	Motor generator	General Electric Co.
1	20-kw.	Brake beam testing machine	Tinius Olsen Testing Machine Co.
1	50,000-lb.	Spring testing machine	Tinius Olsen Testing Machine Co.
1	80,000-lb.	Paint spraying machine	DeVilbiss Manufacturing Co.
1	.....	Steam hammer	Niles-Bement-Pond Co.
1	1,500-lb.	Beaudry power hammer	Manning, Maxwell & Moore
1	No. 10	Vertical punches	Jos. T. Ryerson & Son.
2	.....	Shearing machine	Henry Pels & Co.
1	.....	Doelger & Kirsten shear	Manning, Maxwell & Moore
1	.....	Rod straightener and shear	C. E. McArthur
1	.....	Combination punch and shears	Henry Pels & Co.
7	No. 20	Bending roll	Niles-Bement-Pond Co.
1	No. 7	Pony brake	Chicago Pneumatic Tool Co.
1	.....	Forge blowers	Buffalo Forge Co.
2	No. 5-E	Electric forge blower	Buffalo Forge Co.
1	.....	Pressure blower	Buffalo Forge Co.
1	.....	Vertical chisel mortiser	Hall & Brown Woodwk. Mach. Co.
1	.....	Planer jointers	Hall & Brown Woodwk. Mach. Co.
2	No. 197	Tenoner	Hall & Brown Woodwk. Mach. Co.
1	No. 55	Finishing planers	Hall & Brown Woodwk. Mach. Co.
2	No. 183	Woodward & Powell planer	Manning, Maxwell & Moore
1	.....	Cut-off saw	J. A. Fay & Egan Co.
1	No. 364	Swing saw	Hall & Brown Woodwk. Mach. Co.
1	No. 210	Shaper	Hall & Brown Woodwk. Mach. Co.
1	No. 188	Lightning spindle	J. A. Fay & Egan Co.
1	No. 454	Pneumatic hoists	Manning, Maxwell & Moore
2	5-ton	Pneumatic hoists	Ingersoll-Rand Co.
2	.....	Electric traveling cranes	Manning, Maxwell & Moore
2	.....	Cranes	Euclid Crane & Hoist Co.
2	10-ton	Crane	Manning, Maxwell & Moore
1	.....	Crane and hoist	Shepard Elec. Crane & Hoist Co.
1	.....	D. C. motors	U. S. Light & Heat Corp.
2	220-volt	Motor generators	Westinghouse Electric & Mfg. Co.
2	7½-kw.	Welders	U. S. Light & Heat Corp.
4	300-amp.	Valve setting machines	Morgan Engineering Co.
2	.....	Vertical test machine	Riehle Bros. Testing Mach. Co.
1	50,000-lb.		

Mobile & Ohio

1	16-in. by 9-ft.	Engine lathe	Lehman Machine Co.
1	18-in. by 10-ft.	Engine lathe	Cisco Machine Tool Co.
1	18-in. by 10-ft.	Engine lathe	Boye & Emmes Machine Tool Co.
1	18-in. by 10-ft.	Engine lathe	Monarch Machine Tool Co.
1	18-in. by 11-ft.	Engine lathe	Lehman Machine Co.
1	20-in. by 6-ft. 6-in.	Engine lathe	Dresses Machine Tool Co.
4	20-in. by 10-ft.	Engine lathes	Boye & Emmes Machine Tool Co.
1	20-in. by 11-ft.	Engine lathe	Lehman Machine Co.
1	20-in. by 12-ft.	Engine lathe	Boye & Emmes Machine Tool Co.
1	20-in. by 12-ft.	Engine lathe	Cisco Machine Tool Co.
1	24-in. by 12-ft.	Engine lathe	Cisco Machine Tool Co.
1	24-in. by 13-ft.	Engine lathe	Lehman Machine Co.
1	24-in. by 14-ft.	Engine lathe	Boye & Emmes Machine Tool Co.
1	30-in. by 14-ft.	Engine lathe	Boye & Emmes Machine Tool Co.
1	42-in. by 18-ft.	Lathe	Manning, Maxwell & Moore
1	90-in.	Putnam engine lathe	Manning, Maxwell & Moore
1	90-in.	Putnam wheel lathe	Niles-Bement-Pond Co.
1	.....	Lathe	Niles-Bement-Pond Co.
1	36-in.	Car wheel lathe	International Machine Tool Co.
1	3-in. by 36-in.	Turret lathe	Jones & Lamson Machine Co.
1	3½-in. by 44-in.	Turret lathe	Acme Machine Tool Co.
1	.....	Turret lathe	Warner & Swasey Co.
1	2½-ft.	Radial drill	Dresses Machine Tool Co.
2	5-ft.	Radial drills	American Tool Works
1	.....	Radial drill	Barnes Drill Co.
1	34-in.	Upright drill	W. F. & J. Barnes Co.
1	36-in.	Upright drill	Foote-Burt Co.
1	2-spindle	Sensitive drilling machine	Francis Reed Co.
1	4-in.	Centering machine	Pratt & Whitney Co.
1	.....	Staybolt drilling machine	Taylor & Fenn Co.
1	36-in. by 36-in. by 12-ft.	Planer	G. A. Gray Co.
1	36-in. by 36-in. by 12-ft.	Planer	Niles-Bement-Pond Co.
1	48-in. by 48-in. by 18-ft.	Planer	Niles-Bement-Pond Co.
2	32-in.	Shapers	Cincinnati Shaper Co.
1	32-in.	Draw cut pillar shaper	Morton Manufacturing Co.
1	36-in.	Draw cut shaper	Morton Manufacturing Co.
1	24-in.	Newton crank slotting machine	Consolidated Machine Tool Corp.
1	54-in.	Vertical turret lathe	Bullard Machine Tool Co.
1	36-in. by 44-in.	Boring mill	Niles-Bement-Pond Co.
1	.....	Boring and turning mill	Gisholt Machine Co.
1	30-in. by 24-in. by 10-ft.	Milling machine	Ingersoll Milling Machine Co.
2	.....	Milling machines	Cincinnati Milling Machine Co.
1	18-ft. by 30-in. by 96-in.	Gap grinder	Norton Co.
1	.....	Internal and link grinder	Gisholt Machine Co.
3	.....	Floor grinders	J. G. Blount Co.
2	.....	Floor grinders	U. S. Electrical Tool Co.
1	5-hp.	Motor grinder	J. G. Blount Co.

No.	Size and capacity	Type of machine	Builder or dealer
1	50,000-lb.	Brake beam testing machine	Tinius Olsen Testing Machine Co.
1	80,000-lb.	Spring testing machine	Tinius Olsen Testing Machine Co.
1		Paint spraying machine	DeVilbiss Manufacturing Co.

New York Central (Continued)

No.	Size and capacity	Type of machine	Builder or dealer
2	6-ft.	Radial drill presses	Manning, Maxwell & Moore
1	6-ft.	Radial drill press	Niles-Bement-Pond Co.
1	14-in.	Upright drill press	Chas. G. Allen Co.
3	26-in.	Upright drill presses	Niles-Bement-Pond Co.
1	¼-in. to 5⅛-in.	Centering machine	Manning, Maxwell & Moore
1	½-in. to 6-in.	Centering machine	Manning, Maxwell & Moore
1	2½-in. to 4-in.	Centering machine	Niles-Bement-Pond Co.
3	24-in.	Shapers	Jos. T. Ryerson & Son
4	32-in.	Shapers	Manning, Maxwell & Moore
1	24-in.	Boring mill	Bullard Machine Tool Co.
1	44-in.	Boring mill	Niles-Bement-Pond Co.
1	44-in.	Boring mill	Manning, Maxwell & Moore
1	48-in.	Boring mill	Wm. Sellers & Co., Inc.
1	54-in.	Boring mill	Wm. Sellers & Co., Inc.
1	100-in.	Boring mill	Consolidated Machine Tool Corp.
1	.....	Boring mill	Landis Machine Co.
1	No. 3	Milling machine	Cincinnati Milling Machine Co.
1	No. 5	Cincinnati milling machine	Henry Frentiss & Co.
2	.....	Horizontal slab milling machines	Ingersoll Milling Machine Co.
1	.....	Milling machine	Ingersoll Milling Machine Co.
1	No. 3	Key seating machine	Niles-Bement-Pond Co.
1	No. 13	Tool and surface grinder	Brown & Sharpe Mfg. Co.
1	.....	Vertical surface grinder	Henry Prentiss & Co.
1	6-in.	Floor grinder	U. S. Electrical Tool Co.
1	12-in.	Floor grinder	Cincinnati Electrical Tool Co.
1	16-in.	Electric grinder	U. S. Electrical Tool Co.
1	.....	Double grinder	Henry Prentiss & Co.
1	.....	Double grinder	Ransom Manufacturing Co.
2	.....	Double grinders	Niles-Bement-Pond Co.
1	10⅝-in. by 22-in.	Cutter and tool grinder	Wilmarth Morman Co.
1	.....	Die sharpener	Niles-Bement-Pond Co.
1	4-in. by 24-in.	Knife grinder	Manning, Maxwell & Moore
1	1-hp.	U. S. bench buffer	Henry Prentiss & Co.
1	8-in. by 8-in.	Hack saw	Peerless Machine Co.
3	.....	Cylinder boring bars	Manning, Maxwell & Moore
1	.....	2-cylinder facing machine	Manning, Maxwell & Moore
1	2-in.	Bolt cutter	Landis Machine Co.
1	2-in.	Pipe threading machine	Landis Machine Co.
1	4-in.	Pipe threader	Landis Machine Co.
1	15-ton	Broaching and forging press	Manning, Maxwell & Moore
4	50-ton	Bushing presses	Manning, Maxwell & Moore
1	100-ton	Bushing press	Manning, Maxwell & Moore
1	800-ton	Wheel press	R. D. Woods & Co.
1	3,500-lb.	Steam hammer	Erie Foundry Co.
1	⅛-in. by 48-in.	Power squaring shear	Niagara Machine & Tool Works
1	3/16-in.	Nibbling machine	A. C. Campbell Co.
1	1-B	Nibbling machine	A. C. Campbell Co.
1	.....	Punch and shear	Consolidated Machine Tool Corp.
1	3-in. by 42-in.	Slip roll	Niagara Machine & Tool Works
1	42-in.	Keystone bar folder	Niagara Machine & Tool Works
1	8-ft.	Cornice brake	Niagara Machine & Tool Works
1	10-in.	Buffalo edging machine	Niagara Machine & Tool Works
1	.....	Superior small burr	Niagara Machine & Tool Works
1	.....	Superior large burr	Niagara Machine & Tool Works
1	.....	Superior small turner	Niagara Machine & Tool Works
1	.....	Superior large turner	Niagara Machine & Tool Works
1	No. 02½	Beading machine	Niagara Machine & Tool Works
1	No. 1	Beading machine	Niagara Machine & Tool Works
1	.....	Automatic soot blower	Vincent Gilson Co.
1	.....	Automatic soot blower	Bayer Co.
1	.....	Oil furnace	DeRemer-Blatchford Co.
4	.....	Electric rivet heaters	Humil Corporation
2	4-ft. by 14-ft.	Annealing furnaces	DeRemer-Blatchford Co.
1	No. 4	Soldering gas furnace	Equipment Mfg. & Supply Co.
1	.....	Cut-off saw and table	Oliver Machinery Co.
1	15-hp.	Rip saw	Greenlee Bros. & Co.
1	No. 405	Rip saw	J. A. Fay & Egan Co.
1	No. 500	Variety saw	J. A. Fay & Egan Co.
2	30-in.	Single cylinder surfacers	P. B. Yates Machine Tool Co.
1	No. 369	Planing, matching & molding mach.	J. A. Fay & Egan Co.
1	20-in.	Hand jointer	J. A. Fay & Egan Co.
1	.....	Air motor hoist	Ingersoll-Rand Co.
2	.....	Air brake test racks	Westinghouse Air Brake Co.
2	216-cu. ft.	Air compressors	Ingersoll-Rand Co.
1	1,200-cu. ft.	Air compressor	Chicago Pneumatic Tool Co.
1	2,440-lb.	Electric crane truck	Elwell-Parker Electric Co.
4	3,000-lb.	Electric trucks	Elwell-Parker Electric Co.
1	4,000-lb.	Electric lift truck	Elwell-Parker Electric Co.
1	.....	Universal cutter and tool grinder	Wilmarth-Morman Co.
1	.....	Chaser grinder	Landis Machine Co.
1	½-in. to 3-in.	Automatic drill pointer	Oliver Instrument Co.
1	.....	Die sinking grinder	Keller Mech. Engineering Corp.
1	3½-in. by 6-ft.	Boring bar	H. B. Underwood Corp.
1	6-in. by 8-ft.	Boring bar	H. B. Underwood Corp.
2	¼-in. to 2-in.	Pipe threading and cutting mach.	Oster Manufacturing Co.
1	½-in. to 8-in.	Pipe threading machine	Toledo Pipe Threading Machine Co.
1	50-ton	Power forcing press	Lucas Machine Tool Co.
1	48-in.	Trimming press	E. W. Bliss Co.
1	4,000-lb.	Drop hammer	Erie Foundry Co.
1	⅛-in.	Rotary shear	Marshalltown Manufacturing Co.
1	¾-in.	Pneumatic flanging machine	McCabe Manufacturing Co.
1	2¼-in.	Bar machine	Cleveland Automatic Machine Co.
1	4½-in.	Bar machine	Cleveland Automatic Machine Co.
1	8-in. by 12-in. by 22-in.	Electric furnace	Westinghouse Electric & Mfg. Co.
1	8-in. by 12-in. by 28-in.	Hearth furnace	Westinghouse Electric & Mfg. Co.
1	2-ton	Electric hoist	Shepard Electric Crane & Hoist Co.
1	10-ton	Traveling crane	Niles-Bement-Pond Co.
1	800-lb.	Electric tractor	Baker R. & L. Co.
1	3,000-lb.	Electric crane truck	Baker R. & L. Co.
3	30-cu. ft.	Tructractors	Clark Tructractor Co.
3	46-in. by 124-in.	Tructractors	Clark Tructractor Co.
2	1,500-lb.	Tructractors	Clark Tructractor Co.
10	3-ton	Platform trailers	Lakewood Engineering Co.
28	4-ton	Platform trailers	Mercury Mfg. Co.
10	5-ton	Platform trailers	Lakewood Engineering Co.
15	1-yd.	Side dump trailers	Mercury Manufacturing Co.

Oregon Short Line

1	5-ft.	Radial drill	American Tool Works
1	44-in.	Boring and turning mill	Manning, Maxwell & Moore
1	No. 10	Trimming press	Erie Foundry Co.
1	1,500-lb.	Steam drop hammer	Niles-Bement-Pond Co.
1	1½-in. to 3-in.	Flue cutting-off machine	Jos. T. Ryerson & Son

Oregon-Washington Railroad & Navigation Co.

3	No. 29	Drill presses	Canedy-Otto Mfg. Co.
1	.....	Electric grinder	Stand & Co.
1	36-in.	Power gap shear	Kutscheid Manufacturing Co.
1	5-ft. 10-in. by 16-ft. 6-in.	Annealing furnace	DeRemer-Blatchford Co.
1	12-in. by 8-in. by 33-in.	Electric furnace	Hoskins Manufacturing Co.

Pacific Fruit Express

1	26-in.	Aurora drill	Niles-Bement-Pond Co.
1	36-in. by 4½-in.	Grindstone	Cleveland Stone Co.
1	No. 130	Grinding machine	Ransom Manufacturing Co.
1	1½-in.	Bolt threading machine	Landis Machine Co.
1	No. 2	Power hammer	Nazel Engineering & Mach. Works
1	No. 21.	Punch and shear	Henry Pels & Co.
2	No. 86	Forges	Buffalo Forge Co.
1	No. 503	Pressure blower	Mahr Manufacturing Co.
1	10-in.	Four-sided molder	American Woodwk. Machinery Co.
1	24-in.	Swing saw	American Woodwk. Machinery Co.
1	36-in.	Band saw	American Woodwk. Machinery Co.
1	36-in. by 44-in.	Variety saw	American Woodwk. Machinery Co.
1	Model 3-T	Triple valve test rack	New York Air Brake Co.

Panhandle & Santa Fe

1	2-in.	Double head bolt cutter	Marshall & Huschart Mchy. Corp.
1	.....	Portable crank pin press	Watson-Stillman Co.
1	3-hp.	Induction motor	General Electric Co.

Pennsylvania System

1	.....	Journal truing lathe	
4	.....	Engine lathes	
4	.....	Turret lathes	
1	.....	Car wheel lathe	
1	.....	Lathe and boring machine	
1	.....	Automatic screw machine	
3	.....	Radial drills	
2	.....	Drill presses	
1	.....	Sensitive drill	
2	.....	High duty drills	

No.	Size and capacity	Type of machine	Builder or dealer
1	.....	Electric crane truck	Elwell-Parker Electric Co.
1	.....	Tractor and snow sweeper	Ford Motor Co.
1	1½-hp.	Motor for drill press	General Electric Co.
1	2-hp.	Motor	General Electric Co.
1	3-hp.	Motor	General Electric Co.
1	10-hp.	Motor	General Electric Co.
1	30-hp.	Motor	R. D. Woods & Co.
10-kw.		Generator set	Wooten Co.
1	.....	Motor generator set	S. Pitman Electric Corp.
1	12.5-kw.	Battery charging plant	Electric Products Co.
1	550-volt	Welder	Electric Arc Cutting & Welding Co.
1	.....	Automatic welder and generator ..	S. Pitman Electric Corp.
1	.....	Electric welder	C. & C. Electric Mfg. Co.
4	48-in.	Half-round iron horses	Railway Devices Co.
1	4-ft. 3-in. by 5-ft. ½-in. by 29-in...	Metal cleaning machine	Crescent Washing Machine Co.
1	235-cu. ft.	Aftercooler	Ingersoll-Rand Co.
1	560-cu. ft.	Aftercooler	Ingersoll-Rand Co.
1	4-ft. 5-in. by 12-ft. 1½-in. by 2-ft...	Adjusting machine	Walter Stock Adjusting Mach. Co.

New York, Chicago & St. Louis

1	No. 3	Axle lathe	Niles-Bement-Pond Co.
1	90-in.	Journal lathe	Niles-Bement-Pond Co.
1	2½-in.	Turret lathe	Warner & Swasey Co.
1	5-ft.	Radial drill press	American Tool Works
1	36-in. to 44-in.	Side head boring mill	Niles-Bement-Pond Co.
1	2-in. by 14-in.	Electric floor grinder	Hisey-Wolf Machine Co.
1	3-in. by 18-in.	Electric floor grinders	Hisey-Wolf Machine Co.
1	No. 1	Racine hack saw	Niles-Bement-Pond Co.
1	1½-in.	Staybolt cutter	Landis Machine Co.
1	2-in.	Pipe machine	Bignall & Keller Mfg. Works
1	600-ton	Driving wheel press	Chambersburg Engineering Co.
1	.....	Punch and shear	Cleveland Punch & Shear Works
1	36-in.	Self-feed rip saw	Greenlee Bros. & Co.
1	6-ft. by 8-ft.	Oil forging furnace	Ferguson Furnace Co.
1	300-amp.	Electric welder	Lincoln Electric Co.

New York, New Haven & Hartford

1	16-in.	Engine lathe	Manning, Maxwell & Moore
1	6-ft.	Radial drill	Carlton Machine Tool Co.
1	6-ft.	Radial drill	American Tool Works
1	.....	Rail drilling machine.....	Crerar-Adams & Co.
1	32-in.	Shaper	Gould & Eberhardt
1	44-in.	Driving box borer and facer	Bullard Machine Tool Co.
1	90-in.	Vertical boring and turning mill ..	King Machine Tool Co.
1	6-in. by 6-in.	Hack saw	Peerless Machine Co.
1	No. 0	Locomotive cylinder facing mach..	H. B. Underwood Corp.
1	No. 1	Locomotive cylinder facing mach..	H. B. Underwood Corp.
2	No. 2	Locomotive cylinder facing mach's.	H. B. Underwood Corp.
1	¾-in.	Flanging machine	McCabe Manufacturing Co.
1	30-in. by 12-in.	Single surfacer	American Woodwk. Machinery Co.
1	No. C-85	Wood working machine	Brackett, Shaw & Co.
1	40-in.	Hand feed bevel band saw	American Woodwk. Machinery Co.
1	36-in.	Rip saw machine	Greenlee Bros. & Co.
1	36-in.	Cut-off saw	Greenlee Bros. & Co.
1	2-ton	Gantry crane	Bradney Machine Co.

Norfolk & Western

1	90-in.	Wheel quartering machine	Niles-Bement-Pond Co.
1	18-in. by 10-ft.	Engine lathe	Bradford Machine Tool Co.
1	27-in. by 16-ft.	Engine lathe	Niles-Bement-Pond Co.
4	20-in.	Lathes	Dresses Machine Tool Co.
1	100-per hr.	Journal bearing broaching machine.	Morton Manufacturing Co.
1	5¾-in. spindle	Auto. chucking machine	Potter & Johnston Machine Co.
2	⅞-in.	High speed drilling machines ...	Avery Drilling Machine Co.
4	16-in.	Sensitive drills	Fosdick Machine Tool Co.
1	42-in. by 24-in. by 14-ft.	Planer	G. A. Gray Co.
1	24-in.	Crank shaper	Columbia Machine Tool Co.
1	32-in.	Shaper	Cincinnati Shaper Co.
1	42-in.	Vertical boring mill	Bullard Machine Tool Co.
1	50-in.	Vertical milling machine	Niles-Bement-Pond Co.
1	1⅝-in. to 15-in. dia. to 16-in. deep..	Internal grinder	Micro Machine Co.
1	20-in. by 68-in.	Internal grinder	Micro Machine Co.
1	30-in. by 108-in.	Grinder	Diamond Machine Co.
1	12-in. by 36-in.	Grinding machine	Fitchburg Grinding Machine Co.
1	.....	Universal tool and cutter grinder.	R. K. LeBlond Machine Tool Co.

No.	Size and capacity	Type of machine	Builder or dealer
1	.....	Close quarter drill.....	
1	.....	Bolt centering machine	
1	.....	Crank planer	
2	.....	Horizontal boring & turning mach.....	
2	.....	Horizontal boring & drilling mach.....	
1	.....	Vertical boring mill	
1	.....	Boring mill	
6	.....	Milling machines	
1	.....	Link grinding machine	
2	.....	Tool grinders	
3	.....	Wet tool grinders	
4	.....	Grinding machines	
1	.....	Double motor driven grinder	
1	.....	Angle cock grinding machine	
2	.....	Hack saws	
6	.....	Portable head and dome facing machines	
1	.....	Horizontal boring and facing mach	
2	.....	Bolt threaders	
1	.....	Air hose nipple threader	
2	.....	Pipe cutting & threading machines.....	
1	.....	Pipe bending machine	
1	.....	Turning and threading machine	
1	.....	Bolt pointing machine	
1	.....	Nut tapper	
1	.....	Hydraulic wheel press	
2	.....	Bushing presses	
1	.....	Twin straightening press	
1	.....	Brake beam straightening press	
1	.....	Straightening press and furnace	
1	.....	Coupler straightening press	
1	.....	Steam hammer	
1	.....	Bolt straightening hammer	
1	.....	Rotary splitting shear	
1	.....	Straightener and shear	
1	.....	Double end punch and shear	
1	.....	Punch and shear	
1	.....	Flue safe end welding mach.	
1	.....	Safe end cutter and scarfer	
1	.....	Flue mill	
1	.....	Swedging machine	
1	.....	Planer and matching machine	
2	.....	Rip saws	
1	.....	Wood saw	
1	.....	Electric traveling crane	
3	.....	Cranes	
85	.....	Jib cranes and hoists	
1	.....	Gasoline crane	
18	.....	Shop trucks	
11	.....	Electric welding outfits	

Peoria & Eastern

1	25-in.	Upright drill press	Weigel Machine Tool Co.
1	42-in.	Vertical boring & turning machine.	King Machine Tool Co.
1	1½-in.	Double head bolt cutter	Landis Tool Co.
1	784-cu. ft.	Air compressor	Chicago Pneumatic Tool Co.
1	200-amp.	Arc welding equipment	Westinghouse Electric & Mfg. Co.

Pere Marquette

1	36-in. by 6-in.	Double surfacer	P. B. Yates Machine Co.
1	12-in. by 8-in.	Four-side molder.....	P. B. Yates Machine Co.
1	24-in.	Hand jointer	Oliver Machinery Co.
1	No. 16	Ball bearing belt sander.....	American Woodwk. Machinery Co.

Pittsburgh & Lake Erie

1	1½-in	Single head threading machine....	Landis Machine Co.
1	4-in. round, 3¾-in. square.	Alligator shear	Doelger & Kirsten Co.
1	50-ton	Drop pit jack	Whiting Corp.
1	10-ton	Electric traveling crane.....	Manning, Maxwell & Moore
1	25-ton	Locomotive crane	Ohio Locomotive Crane Co.
3	3,000-lb.	Electric crane trucks.....	Elwell-Parker Electric Co.

Pittsburgh & Shawmut

1	14-in.	Wet tool grinder.....	J. G. Blount Co.
1	No. 2	Rivet forge	Mead-Morrison Mfg. Co.

Pittsburgh, Shawmut & Northern

No.	Size and capacity	Type of machine	Builder or dealer
1		Air compressor	Ingersoll-Rand Co.

Public Belt R. R. of New Orleans

1	80-in.	Driving wheel lathe	Manning, Maxwell & Moore
1	21-in.	LeBlond lathe	Oliver H. Van Horn Co.
1	36-in.	Lathe	Manning, Maxwell & Moore
1	2-in.	Landis bolt threading machine	Woodward, Wight & Co.
1	1,100-lb.	Forging hammer	Manning, Maxwell & More
1	Size E	Hilles & Jones punch and shear	C. T. Patterson Co.
1		Locomotive hoist	Whiting Corp.
1	70-in.	Locomotive crane	Baker R. & L. Co.
1	8,000-lb.	Electric Hoist	Shepard Electric Crane & Hoist Co.

Reading Co.

1	90-in.	Driving wheel lathe	Wm. Sellers & Co., Inc.
1	32-in.	Shaper	Gould & Eberhardt
1	32-in.	Shaper	Columbia Machine Tool Co.
1	No. 425	Drilling and boring machine	Baker Brothers
1	1-in. to 4-in.	Pipe thread. and cutting-off mach.	Oster Manufacturing Co.
1	600-ton	Hydraulic wheel press	Watson-Stillman Co.
1	5,000-lb.	Electric hoist	Roeper Crane & Hoist Co.
1	1,500-lb.	Electric crane truck	Crescent Truck Co.
13	4,000-lb.	Electric platform trucks	Crescent Truck Co.

Richmond, Fredericksburg & Potomac

1	20-in.	Engine lathe	American Tool Works
1		Car axle lathe	Manning, Maxwell & Moore
1	3½-ft.	Radial drill press	American Tool Works
1	24-in.	Upright drill press	Foote-Burt Co.
1	48-in.	Car wheel boring mill	Manning, Maxwell & Moore
1	No. 2	Drill grinder	Wm. Sellers & Co., Inc.
1		Die sharpener	National Machinery Co.
1	500-ton	Car wheel press	Chambersburg Engineering Co.
1	1,500-lb.	Steam hammer	Chambersburg Engineering Co.
1	No. 351	Wood borer	Greenlee Bros. & Co.
1	No. 3	Scroll saw	J. A. Fay & Egan Co.
1	20-in.	Joiner	C. O. Porter Machinery Co.
1	No. 8	Saw and dado machine	American Woodwk. Machinery Co.
1	No. 70	Tenoning machine	J. A. Fay & Egan Co.
2	25-ton	Car jacks	Whiting Corp.
1	600-cu. ft	Air compressor	Chicago Pneumatic Tool Co.

St. Joseph & Grand Island

1	Type KRE-2	Air compressor	Ingersoll-Rand Co.
1	220-amp.	Arc welding machine	Westinghouse Electric & Mfg. Co.

St. Louis-San Francisco

1		Double head axle lathe	
1	16-in. by 8-ft.	Toolroom lathe	
1	5-ft.	Radial drill press	
1	32-in.	Shaper	
1	42-in.	Switch and frog planer	
1		Planer	
1		Driving box boring mill	
2		Internal grinders	Heald Machine Co.
1		Drill grinder	Oliver Machinery Co.
1		Grinding machine	
1	No. 3	Hacksaw	
1		Boring bar	
3	150-ton	Vertical bushing presses	
1		Elliptic spring forming machine	
1	2,000-lb.	Steam hammer	
1		Slitting shears	
1		Band saw	

No.	Size and capacity	Type of machine	Builder or dealer
1	No. 2	Electric forge blower	Champion Blower & Forge Co.
1		Electric forge blower	Buffalo Forge Co.
1	10-ton	Traveling crane	Niles-Bement-Pond Co.
1	8-ton	Hoist	American Engineering Co.
1	30-ton	Gantry crane	Manning, Maxwell & Moore
1	200-amp.	Welding generator	U. S. Light & Heat Corp.

Spokane, Portland & Seattle

1	24-in.	Upright drill press	Superior Machine Tool Co.

Terminal Railroad Association of St. Louis

1	14-in.	Internal and link grinder	Gisholt Machine Co.
1	100-lb.	Power hammer	Beaudry & Co.
1	1-in. by 8-in.	Hand bending machine	Kerlin Co.
1	200-amp.	Arc welder	General Electric Co.

Toledo Terminal

1	36-in. to 44-in.	Boring mill	Niles-Bement-Pond Co.

Texas & Pacific

1	5-ft.	Radial drill press	Niles-Bement-Pond Co.
1	32-in.	Upright drill	Niles-Bement-Pond Co.
1	20-in. by 20½-in.	Wet tool grinder	Niles-Bement-Pond Co.
1	No. 206	Floor grinder	Hisey-Wolf Machine Co.
1	200-lb.	Helve hammer	Manning, Maxwell & Moore
1	No. 7	Flanging machine	McCabe Manufacturing Co.
1	20-in. by 2-in.	Eight-roll boss timber dresser	American Woodwk. Machinery Co.

Union Pacific

2	No. 3	Axle lathes	Niles-Bement-Pond Co.
1	18-in. by 8-ft.	Engine lathe	Monarch Machine Tool Co.
1	18-in. by 10-ft.	Engine lathe .....?	Boye & Emmes Machine Tool Co.
1	24-in. by 14-ft.	Engine lathe	Boye & Emmes Machine Tool Co.
1	55-in.	Betts truing lathe	Consolidated Machine Tool Corp.
1	1⅞-in.	Screw machine	Manning, Maxwell & Moore
1	2-ft.	Radial drill	American Tool Works
1	5-ft.	Radial drill	Dresses Machine Tool Co.
1	6-ft.	Radial drill	Niles-Bement-Pond Co.
1	No. 17	Two spindle drill	Foote-Burt Co.
1	32-in.	Newton planer	Consolidated Machine Tool Corp.
1	32-in.	Shaper	Columbia Machine Tool Co.
1	18-in.	Slotting machine	Manning, Maxwell & Moore
1	48-in.	Boring mill	Niles-Bement-Pond Co.
1	No. 2A	Milling machine	Brown & Sharpe Mfg. Co.
1	25-hp.	Rotary milling machine	Ingersoll Milling Machine Co.
1	18-in. to 100-in.	Radius grinder	Rockford Tool Co.
2	18-in.	Grinders	Micro Machine Co.
1	No. 1	Die sharpener	National Machinery Co.
1	5 WFA	Floor grinder	Hisey-Wolf Machine Co.
1	No. 8	Little David pedestal grinder	Fuchs Equipment Co.
1	3/32-in. to 4-in.	Drill grinder	
1	¼-in. to 2-in.	Pipe threading machine	Oster Manufacturing Co.
1	250-ton	Car wheel press	Chambersburg Engineering Co.
1	300-ton	Press	Chambersburg Engineering Co.
1	No. 22	Eye bolt machine	Williams, White & Co.
2	No. 1½	Punch and shears	Long & Allstatter Co.
1	52-in.	Foot gap shear	Niagara Machine & Tool Works
1	Up to 6-in.	Flue welder	Thomson Electric Welding Co.
1	12-ft.	Flanging clamp	Niles-Bement-Pond Co.
1	No. 4	Forming machine	Jos. T. Ryerson & Son
1	8-ft. 1-in.	Brake	Dreis & Krump Mfg. Co.
2	No. 4	Electric rivet heaters	American Car & Foundry Co.
1	12-in. by 8-in. by 26-in.	Furnace	Hoskins Manufacturing Co.
1	18-in.	Cut-off saw	J. A. Fay & Egan Co.
1	21-in.	Cut-off saw	J. A. Fay & Egan Co.
1	21½-in by 4¼-in.	Rip saw	J. A. Fay & Egan Co.
1	200-ton	Locomotive hoist	Whiting Corp.
1	8-ton	Hoist	Pawling & Harnischfeger Co.

4	3-T	A.R.A. triple valve test racks	
2	1,500-cu. ft.	Air compressors	
10		Electric welding machines	

St. Louis-Southwestern

No.	Size and capacity	Type of machine	Builder or dealer
1	20-40-in. by 10-ft.	Bed gap lathe	Rahn-Larmon Co.
1	3-ft.	Radial drill	Dresses Machine Tool Co.
1	34-in.	Upright drill	W. F. & J. Barnes Co.
1	14-in.	Sensitive floor drill	U. S. Machine Tool Co.
1	20-in.	Shaper	Gould & Eberhardt
1	No. 5	Milling machine	Cincinnati Milling Machine Co.
1	No. 3 BXA	Combination grinder	Hisey-Wolf Machine Co.
1	No. 6 WFA	Double emery wheel grinder	Hisey-Wolf Machine Co.
1	Type M	Parallel grinder	U. S. Electric Co.
1		Chaser grinder	Landis Machine Co.
1	12-in.	Crank pin turning machine	H. B. Underwood Corp.
1	1½-in.	Bolt and pipe cutter	Landis Machine Co.
1	2-in.	Bolt and pipe cutter	Landis Machine Co.
1	2-in.	Single head bolt cutter	Landis Machine Co.
1	1½-in.	Triple head bolt cutter	Landis Machine Co.
1	1,500-lb.	Steam hammer	Massillon Foundry & Machine Co.
1	No. 2	Post borer	J. A. Fay & Egan Co.
1	4-in.	Hand planer and jointer	J. D. Wallace & Co.
2	6-in.	Hand planer and jointer	J. A. Fay & Egan Co.
1	8-in.	Hand planer and jointer	J. A. Fay & Egan Co.
1	15-in.	Disc sander and grinder	Porter-Cable Machine Co.
1	43-in. by 8-in.	Triple drum roll feed sander	P. B. Yates Machine Co.
1	30-in.	Band saw	J. A. Fay & Egan Co.
1	48-in.	Circular saw sharpener	Machinery Company of America
1	No. 2	Electric rivet heater	American Car & Foundry Co.
2	6,000-lb.	Pneumatic hoists	Independent Pneumatic Tool Co.
1	1,000-lb.	Electric hoist	Shepard Electric Crane & Hoist Co.
1	2,000-lb.	Electric hoist	Shepard Electric Crane & Hoist Co.
3	10,000-lb.	Electric hoists	Shepard Electric Crane & Hoist Co.
1	3,000-cu. ft.	Air compressor	Worthington Pump & Mchy. Co.

St. Paul Bridge & Terminal Co.

1	1-hp.	Electric bench grinder	Cincinnati Electrical Tool Co.
1	2-in.	Flue cleaning machine	Lagonda Manufacturing Co.

Southern

2	26-in.	Upright drills	W. F. & J. Barnes Co.
1	48-in.	Drill press	Reed-Prentice Co.
1	18-in. by 8-ft.	Engine lathe	Cisco Machine Tool Co.
1	18-in. by 10-ft.	Engine lathe	Cisco Machine Tool Co.
1	24-in. by 12-ft.	Engine lathe	Cisco Machine Tool Co.
1	36-in. by 36-in. by 10-ft.	Planer	Niles-Bement-Pond Co.
1	32-in.	Shaper	Columbia Machine Tool Co.
1	53-in.	Boring and turning mill	Niles-Bement-Pond Co.
1	No. 76	Floor grinder	Safety Emery Wheel Co.
1	18-in. by 18-in., 12-in. wheel	Polishing spindle	Rochester Electric Products Corp.
1	18-in. by 18-in., 14-in. wheel	Polishing spindle	Rochester Electric Products Corp.
1	18-in. by 18-in., 16-in. wheel	Polishing spindle	Rochester Electric Products Corp.
1	No. 14 K	Hacksaw machine	E. C. Atkins & Co.
1	4½-in. by 6-in.	Boring bar	H. B. Underwood Corp.
1	No. 102	Boring bar	H. B. Underwood Corp.
1	26-in.	Valve seat planer	H. B. Underwood Corp.
1	2-in.	Bolt cutter	Niles-Bement-Pond Co.
1	62-in.	Pressure blower	Buffalo Forge Co.
1	No. 536	Car tenoner and gainer	Greenlee Bros. & Co.
1	36-in.	Rip saw	Greenlee Bros. & Co.
1	No. 456	Cut-off saw	Greenlee Bros. & Co.
1	No. 325	Knife balancing machine	J. A. Fay & Egan Co.
1	No. 101	Knife grinder	J. A. Fay & Egan Co.
1	200-amp.	Electric welding outfit	Westinghouse Electric & Mfg. Co.

Southern Pacific

1	Type FFA	Cincinnati grinder	Waterhouse & Lester Co.
1	1½-in.	Landis bolt threading machine	Woodward, Wight & Co.
1	¾-in.	Upsetting and forging machine	Acme Machinery Co.
3		Wire nail making machines	National Machinery Co.
1	10-ft.	Locomotive crane truck	W. F. Hebard Co.
1	200-amp.	Arc welder	Westinghouse Electric & Mfg. Co.
1	35-ton	Hydraulic testing machine	Jos. T. Ryerson & Son.

Wabash

No.	Size and capacity	Type of machine	Builder or dealer
1	42-in.	Putnam journ. turn. and axle lathe	Manning, Maxwell & Moore
6	18-in.	Engine lathes	Lehmann Machine Co.
2	24-in.	Engine lathes	Lehmann Machine Co.
1	30-in.	Engine lathe	Boye & Emmes Machine Tool Co.
2		Hand lathes	U. S. Metallic Packing Co.
2	3-ft.	Radial drills	American Tool Works
1	26-in.	Upright drill press	Niles-Bement-Pond Co.
1	44-in.	Upright drill press	W. F. & J. Barnes Co.
1	No. 2	Drill press	Avery Drilling Machine Co.
1	32-in.	Crank shaper	Ohio Machine Tool Co.
1	32-in.	Crank shaper	J. J. O'Brien Machinery Co.
1	48-in.	Car wheel borer	Niles-Bement-Pond Co.
1	24-in. by 71-in.	Bar grinder	Diamond Machine Co.
1	No. 66-A	Pattern maker's lathe	Oliver Machinery Co.
1	32-in.	Knife grinder	Hall & Brown Woodwk. Mach. Co.
1	52-in.	Saw blade sharpener	Jos. T. Ryerson & Son
2	20-in.	Emery wheel stands	Norton Co.
2	20-in. by 3-in.	Emery wheel stands	Elliot-Stephens Machine Co.
1	No. 5	Hack saw	Armstrong-Blum Mfg. Co.
1	No. 8	Metal cutting band saw	Armstrong-Blum Mfg. Co.
1	No. 109	Cylinder and dome facing machine	H. B. Underwood Corp.
1	No. 121	Valve chamber boring bar	H. B. Underwood Corp.
1	1½-in.	Double head bolt cutter	Landis Machine Co.
1	2-in.	Double bolt threader	National Machine Co.
1	No. 2B	Pneumatic hammer	Nagel Engineering & Machine Co.
1	3-in.	Alligator type shear	Canton Foundry & Machine Co.
1	Type C 3-LU	Punch and shear	Henry Pels & Co.
1	No. 12763	Stewart oil-burning hammer forge	Chicago Flexible Shaft Co.
1	No. 4	Oil-burning forging furnace	Ferguson Furnace Co.
1	No. 232	Hollow chisel mortiser	Greenlee Bros. & Co.
1	24-in.	Self-feed rip saw	Greenlee Bros. & Co.
1	36-in.	Band saw	J. A. Fay & Egan Co.
1	No. 264	Self-feed rip saw	J. A. Fay & Egan Co.
1	No. 42770	Hand shaper and router	R. L. Carter Co.
1	5-ton	Pneumatic hoist	Detroit Hoist & Machine Co.
1	350-cu. ft.	Air compressor	Worthington Pump & Mchy. Co.
1	500-cu. ft.	Steam-driven air compressor	Worthington Pump & Mchy. Co.
1	1,000-cu. ft.	Air compressor	Worthington Pump & Mchy. Co.
1		Air brake hose stripping and mounting machine	Westinghouse Air Brake Co.
3	150-gal.	Paint mixers	J. H. Day & Co.
1	No. 1	Rubber testing machine	Tinius Olsen Testing Mach. Co.

Western Pacific

1	5-ft.	Radial drill	Ryerson Conradson Co.
1	7½-in. by 34-in.	Grinding machine	Gisholt Machine Co.
1	No. 2	Mortiser	New Britain Tool & Mfg. Co.
1	No. 5	Tenoner	L. Power Co.
1	30-in. by 6-in.	Smoothing planer	P. B. Yates Machine Co.
1	295-cu. ft.	Air compressor	Westinghouse Air Brake Co.
1	315-cu. ft.	Air compressor	Westinghouse Air Brake Co.
1	200-amp.	Electric welder	U. S. Light & Heat Corp.

Wheeling & Lake Erie

2	200-amp.	Arc welders	Westinghouse Electric & Mfg. Co.

Yazoo & Mississippi Valley

1	20-in. by 10-ft.	Engine lathe	Lodge & Shipley Machine Tool Co.
1	No. 263	Upright drill	W. F. & J. Barnes Co.
1	20-in.	Crank slotting machine	Wm. Sellers & Co., Inc.
1	No. 2	Radius link grinder	Rockford Milling Machine Co.
1	¼-in. to 2¾-in.	Twist drill grinder	Oliver Instrument Co.
1	18-in. by 3-in. by 1½-in.	Double floor grinder	U. S. Electrical Tool Co.
1	No. 304-B	Pipe threading and cutting-off machine	Oster Manufacturing Co.

Manufacturing and stocking bolts in the shop

By Eugene Kennedy

THE idea of manufacturing bolts of various sizes on a Lassiter four-spindle bolt-turning machine, a turret lathe equipped with a taper attachment, or some similar machine, is an old one. But the establishing of a system for the manufacturing and stocking of finished bolts has not been done so extensively. Fig. 2 shows two sample pages taken from a reference book which contains in table form the dimensions of the various bolts that are of the reference book are furnished to the mechanics engaged in the various operations of manufacturing the bolts.

The operator of the bolt-turning machine is supplied with a complete set of gages with which to gage the bolts for diameter and taper. The mechanic in the erecting shop also has access to an identical set of gages so that when reaming a hole he can, upon completion, select a gage

SIZE, WEIGHT, MATERIAL AND MANUFACTURING COSTS OF FINISHED FRAME BOLTS

Diameter of Rough Bar Iron Used	1"				1 1/8"				1 1/4"			
Diameter of Finished Bolts	7/8", 29/32", 15/16"				31/32", 1", 1 1/32", 1 1/16"				1 3/32", 1 1/8", 1 5/32", 1 3/16"			
Length of Bolt - in.	Weight per 100	Cost per 100			Weight per 100	Cost per 100			Weight per 100	Cost per 100		
		Labor	Material	Total		Labor	Material	Total		Labor	Material	Total
3	117	2.45	7.66	10.11	154	2.45	10.09	12.54	199	2.55	13.03	15.58
3 1/2	128	2.50	8.38	10.88	168	2.50	11.00	13.50	216	2.60	14.15	16.75
4	139	2.50	9.10	11.60	182	2.50	11.92	14.42	233	2.60	15.26	17.86
4 1/2	150	2.60	9.83	12.43	196	2.60	12.84	15.44	250	2.70	16.38	19.08
5	161	2.60	10.55	13.15	210	2.60	13.76	16.36	268	2.70	17.55	20.25
5 1/2	172	2.70	11.27	13.97	223	2.70	14.61	17.31	285	2.80	18.67	21.47
6	183	2.70	11.99	14.69	237	2.70	15.52	18.22	302	2.80	19.78	22.58
6 1/2	194	2.80	12.71	15.51	251	2.80	16.44	19.24	319	2.90	20.89	23.79
7	204	2.80	13.36	16.16	265	2.80	17.36	20.16	336	2.90	22.01	24.91
7 1/2	215	2.90	14.08	16.98	279	2.90	18.27	21.17	353	3.00	23.12	26.12
8	226	2.90	14.80	17.70	292	2.90	19.13	22.03	370	3.00	24.24	27.24
8 1/2	237	3.00	15.52	18.52	306	3.00	20.04	23.04	387	3.10	25.35	28.45
9	248	3.00	16.24	19.24	320	3.00	20.96	23.96	404	3.10	26.46	29.56
9 1/2	259	3.10	16.96	20.06	334	3.10	21.88	24.98	421	3.20	27.58	30.78
10	270	3.10	17.69	20.79	348	3.10	22.79	25.89	438	3.20	28.69	31.89
11	292	3.20	19.13	22.33	375	3.20	24.56	27.76	472	3.30	30.92	34.22
12	313	3.30	20.50	23.80	403	3.30	26.40	29.70	506	3.40	33.14	36.54
13	335	3.40	21.94	25.34	430	3.40	28.17	31.57	540	3.50	35.37	38.87
14	357	3.50	23.37	26.87	458	3.50	30.00	33.50	574	3.60	37.60	41.20
15	379	3.60	24.82	28.42	486	3.60	31.83	35.43	609	3.70	39.89	43.59
16	401	3.70	26.27	29.97	513	3.70	33.60	37.30	643	3.80	42.12	45.92
17	422	3.80	27.64	31.44	541	3.80	35.44	39.24	677	3.90	44.34	48.24
18	444	3.90	29.08	32.98	568	3.90	37.20	41.10	711	4.00	46.57	50.57

NOTES: Material cost based on iron, up to 2" @ $.0655 and 2" iron @ $.067.
Labor cost includes shearing, forging, centering, machining and handling, but does not include overhead.

Fig. 1—Chart by which the accounting department can determine the cost of manufacturing bolts of various sizes

manufactured in the shop. This book contains all the data necessary to make locomotive frame bolts, main rod strap bolts, crosshead guide bolts, eccentric strap bolts, crosshead bolts, miscellaneous studs that have been adopted as standard, crosshead studs, and boiler studs. The pages are in blue print form, making a book 9 in. by 2¾ in. wide, a size convenient to carry in one's pocket.

Orders for finished bolts to be placed in stock are issued by the stores department. The order blank shows the number of bolts desired and the section and line number for obtaining the correct data from the reference book. The blacksmith shop procures the round bar, cuts it to the proper lengths, forms the heads and delivers the bolts to the pointing machine after which they are turned on a bolt-turning machine and delivered to the storeroom. Copies which will fit the finishing reamer the same as a bolt should fit the reamer hole. The diameter stenciled on the gage shows the size required and the length is readily ascertained with a rule. This information makes the interpretation of the data given in the reference book comparatively simple.

This system, as outlined, has been used to good advantage in the locomotive shops of the Delaware & Hudson at Colonie, N. Y. It has been found to be much better than the usual practice of fitting bolts by turning on portable engine lathes, which is obviously a slow and costly method. Referring to the sample pages of the reference book shown in Fig. 2, it will be noted that a prime diameter, such as ⅞ in., is shown on the first line under the capition "Size." This is followed by the various

lengths of bolts which advance in ½-in. sizes from 2½ in. up to 9½ in. Each size is assigned to a separate line and all of the sizes of bolts in use having this particular diameter range from the minimum to the maximum sizes as shown. It will also be noted that the diameter increases by 1/32 in. in order to provide for repeated reaming. At the top of the page there is an explanation of the procedure to be used in ordering bolts from stock to fit the reamed hole.

A number of charts, one of which is shown in Fig. 1, have been compiled for the convenience of the accountant in distributing charges accruing on shop orders for bolts. It had been the customary practice to use figures from hand books, catalogues, or manufacturers' price lists for such information as contained on this chart. Information obtained from such sources was not always suitable.

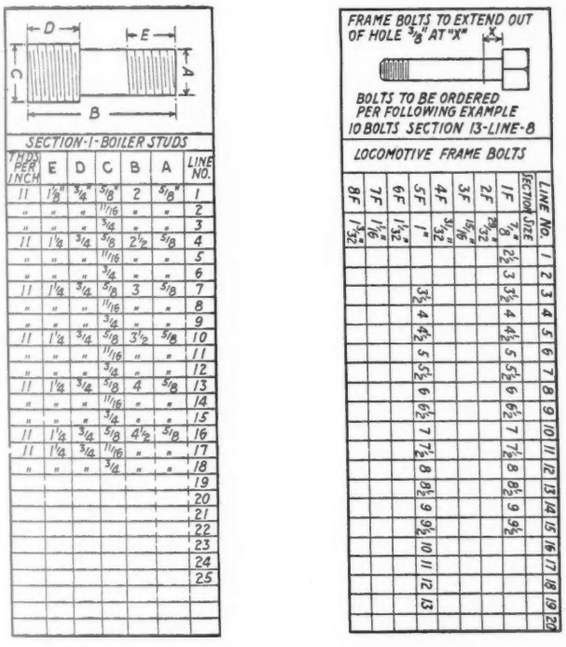


Fig. 2—Sample pages taken from the reference book showing the dimensions of standard bolts

Manufacturing costs vary considerably according to the production methods in use, type of equipment, etc. There is often a wide discrepancy between the actual amount of labor and material expended and the amount which eventually is reported to the accounting department if the charges are determined from time cards. For example, a shop order for 100 finished bolts should accumulate a certain material and labor charge, depending, of course, upon the dimensions. The labor item in all probability is likely to receive a considerable overcharge or vice versa due to an incorrect distribution of charges made by the workmen. This chart was compiled on a decimal basis in order to correct such errors and provide a fixed charge for bolts of all sizes.

Referring again to Fig. 1, it will be noted that the diameter of the rough stock is given. This is subdivided into the finished sizes which, on account of machining, are obviously of smaller diameter. The weights given are for the rough bar after it has been cut to length and previous to forming the head. As the bar from which the bolts are cut is the item which has been bought and paid for, it is obvious that the accounting department is not interested in the weight of the finished bolt. The footnote on the chart explains the basis upon which the material and labor costs have been ascertained.

Complete set of bushings renewed in 1 hr. 9 min.

By J. M. Ganley

Secretary to superintendent of motive power, Wabash, Decatur, Ill.

ON August 10, the Wabash enginehouse forces at Decatur, Ill., renewed a full set of driving rod bushings and knuckle joint bushings in 1 hr. 28 min., but not being satisfied with that, they bettered the time by 19 min. on September 12.

The Wabash Pacific type passenger locomotive No. 664, assigned to fast passenger service between St. Louis, Mo., and Chicago, arrived at Decatur on train No. 13 at 2.45 on the morning of August 10, 1925. It was placed in the enginehouse by the night force and spotted on the left bottom quarter so as to be in position for the renewal of the rods on the left side by the day shift which started work at 7.00 a. m.

At 7.00 a. m. the work of removing the rods was started by the day forces. The left rods, including all side rods, main rod, motion work and eccentric crank were removed and on the floor at 7.08 a. m. The rods were then removed to the enginehouse machine shop where new bushings, including knuckle pin bushings, were applied. They were then returned to the enginehouse and reapplied to the left side of the engine. The main rod motion work, side rods, collar pins, knuckle joint pins and cotter pins, were all in place and the left side of the locomotive was completed at 8.05 a. m.

The right rods were removed and on the floor at 7.19 a. m. The work of removing the rods on the right side was slightly delayed due to the right front collar bolt being galded in the crank pin and it was necessary to use an acetylene torch to burn the bolt out. It was also necessary to use an acetylene torch to burn the nut off of the right knuckle joint pin on account of the cotter pin breaking off in removal and not being able to back it out. The right rods were moved to the machine shop at 7.21 a. m. All new bushings were applied and the rods returned to the enginehouse and reapplied to the locomotive. The right side of the locomotive was completed at 8.28 a. m. and the locomotive was moved out on the turntable at 8.29 a. m. It was dispatched on train No. 9 the same day, at 9.50 a. m.

The total time consumed in performing the work of renewing the entire set of side rod and knuckle joint bushings was as follows:

Time	1 hr. 28 min.
Total man hours	11 hr. 15 min.
Total labor cost	$8.25

In the man-hours is included the time of the gang foreman and the machine foreman.

Not satisfied with this performance, the enginehouse forces at Decatur decided that they could better this and on September 12, 1925, they undertook a similar job on locomotive No. 665, a Pacific type passenger locomotive of the same class as No. 664.

The 665 was spotted in the enginehouse by the night force, as in the case of the 664, but nothing further was done by the night force. At 7.00 a. m. the day shift came on and immediately started the renewing of the bushings on the 665. The eccentric crank, eccentric rod, main rod and all side rods on the left side were on the floor at 7.02 a. m. All rods, eccentric crank, and eccentric rod on the right side were on the floor at 7.04 a. m.

All old bushings were removed from the left rods, new bushings were applied and the rods, eccentric crank and

eccentric rod were in place on the left side of the locomotive at 7.40 a. m.

All the old bushings were removed and new bushings applied to the right side rods and the rods were ready to go up at 7.50 a. m. Difficulty was experienced in getting the right back rod on the pin, having to slip the back drivers on account of the locomotive standing on the right back center. It was necessary to get a switch engine and move the 665 on to the bottom quarter. The right rods were up and everything completed at 8.09 a. m. and the locomotive was moved to the turntable at 8.09 a. m. It left Decatur with train No. 9 at 9.50 a. m.

The total time consumed in renewing the complete set of side rod and knuckle joint bushings on this locomotive was as follows:

Time	1 hr. 9 min.
Man hours	17 hr. 10 min.
Total labor cost	$10.33

The machinery used in both cases was the same. Following is a list of the machine tools that were used for this job:

12-in. lathe	Niles boring machine
30-in. American lathe	Columbia shaper
Bement drill press	Chambersburg rod press
18-in. Prentice lathe	

Absolutely no work of any kind was started on these locomotives prior to 7.00 a. m. except, as has been mentioned, the spotting of the locomotives on arrival in the enginehouse and placing the bushings, in the rough, at the various machines in the machine shop.

The work on locomotive No. 664 was timed by the general road foreman of engines, who was at the enginehouse prior to the time the work commenced to see that no work was done. In the case of the 665, the shop superintendent, the chief draftsman, the traveling boiler foreman, and the road foreman of engines examined the locomotive and bushings before the work actually started to see that nothing had been done and then timed the work from the start until the locomotive was out on the turntable.

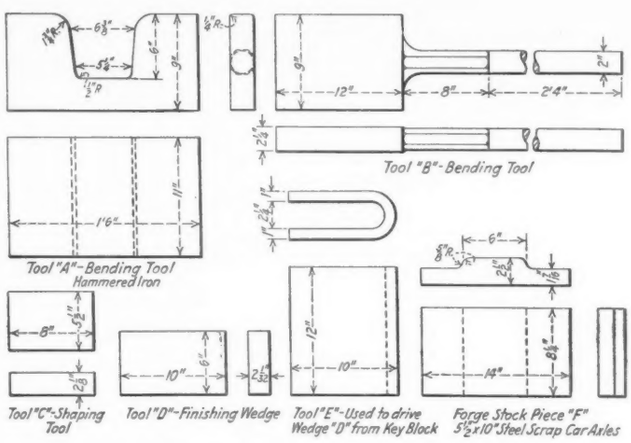
During the renewal of the bushings on the 665, delays were experienced which amounted to 10 min. The first delay occurred in the machine shop, where all of the machines are operated by a lineshaft, which is run by one motor. The belt slipped off the motor pulley causing all the machines to be idle three minutes, while the belt was being replaced. The next delay occurred when applying the rods to the right side, as it was necessary to send for a switch engine, which had to come across the turntable and into the house in order to move the 665 and spot it on the lower quarter. This caused a delay of seven minutes.

Forging back end main rod key blocks

By E. A. Miller

CONSIDERABLE time and expense can be saved in the manufacture of back end main rod key blocks by the use of the forging tools shown in the drawing. The old method of doing this work was to machine each piece from a solid forging after it had been planed up and cut to length. This method eliminates the tedious job of drilling and slotting the block and also saves considerable time.

Referring to the drawing, the piece *F* which is forged from a 5½-in. by 10-in. scrap car axle to the shape shown, is heated and laid with the hump side down on the forming tool *A*. Tool *B* is then placed on the hot forging directly above the groove in tool *A* and the forging is bent to shape by forcing tool *B* down on either a press or a steam hammer until the forging touches the bottom of the groove. The tool *B* and forging is then taken out of the forming tool *A* and is shaped up under the hammer,

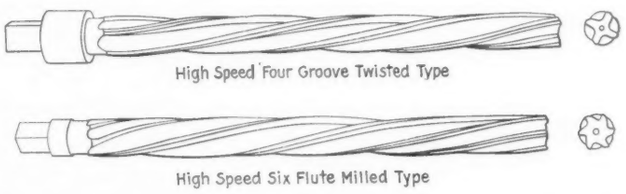

Tool "A"-Bending Tool Hammered Iron
Tool "B"-Bending Tool
Tool "C"-Shaping Tool
Tool "D"-Finishing Wedge
Tool "E"-Used to drive Wedge "D" from Key Block
Forge Stock Piece "F" 5½x10" Steel Scrap Car Axles

Drawing showing a set of tools used in forging back end main rod key blocks

using the shaping tool *C* first, and then finishing with tool *D*. The tool *E* is used to drive the wedge, tool *D*, from the key block. After a minimum amount of machining the key block is ready for application.

Standard reamer proposed by Tool Foremen

ON September 3, 1925, the American Railway Tool Foremen's Association in convention at Chicago, voted to recommend the adoption of standard locomotive frame and rod reamers, drawings of which are reproduced with this article. These reamers will range in size from 1 in. to 2 in. by 1/32-in. steps. The standard flute lengths are 8-, 12-, 16-, 18-, 22- and 26-in., the taper being 1/16



Standard four- and six-flute reamers proposed by the Tool Foremen's Association

in. in 12 in. The spiral is left hand and the spiral angle, 12 to 20 deg. Square shanks are recommended in the 1-in., 1⅛-in., and 1¼-in. sizes, the length of the square being 25 per cent greater than the distance across the flats. The flutes are machine ground to obtain an accurate spiral, the cutting edge being ground with double relief and recessed under the heads to provide run-out for the grinding wheel.

Two types of reamers are approved, namely the high-speed, four-groove twisted type and the high-speed, six-flute milled type.

The Reader's Page

Have You a Question? Ask it
Have You an Opinion? Express it

"The proof of the pudding"

NEW YORK

TO THE EDITOR:

The "Bill Brown—Top Sergeant" controversy is quite interesting. However, it seems that the real basis of comparison has been overlooked—COSTS. It is a case of the final decision resting with the banker. The last group of complete mileage costs shows that "Bill Brown's" road maintained its power for a little more than 19 cents per locomotive mile. The writer does not know who "Top Sergeant" is so he has taken the costs of the twelve "hardest-boiled" railroads in the United States and finds their costs average 37.6 cents per mile. Military methods are all right in emergencies when costs don't count. But in peace times—muster the firing squad and page the undertaker!

DOLLARS AND SENSE

Savings on repair costs

NEWARK, N. J.

TO THE EDITOR:

It is an established fact that the longer a locomotive remains in the shop, the more it costs to repair. This is due to several existing practices, which if changed, would not only reduce the costs of repairs, but also give an added output from the shops.

Locomotives are carded in the shop, needing, let us say, a new cylinder, when the parts needed are not on hand. This locomotive cannot be built in the proper time on account of the missing material. It stands on a pit taking up room that should be occupied by an engine which could be repaired. Also, it is eating up a shop expense of $39.00 a day.

The essential contributing factor to such a situation is that the locomotives do not receive the proper inspection before coming to the shop with the result that defective parts are not located until the engine is in the shop and stripped.

Again, under the present methods of accounting, men must charge out their time against some locomotive. As a result of this practice, a locomotive that is in the shop a long time receives an incorrect labor charge, due to the men bceoming too familiar with the engine number. To remedy these conditions, I would suggest that a thorough inspection be made of a locomotive about due for the shop and the standard defective parts noted. The report should be forwarded to the shop scheduled to make the repairs; the parts obtained and machined as far as possible ready to apply, before the locomotive is ordered in. The locomotive could then be rebuilt rapidly and the time out of service greatly reduced.

An engine comes into the shop for a class five repair and should be out again in nine working days. The report shows a new cylinder and new tires needed. When stripping the locomotive, it is found that both cylinders need renewing. There is only one cylinder on hand and three weeks is lost before the cylinders are ready to apply with the result that the engine is in the shop a month. If the shop were notified that two new cylinders and new tires were needed for a locomotive, it could secure the parts, lay out, drill, bolt and chip the cylinders and bore the tires. It would then notify the enginehouse that it was ready for the locomotive which could be repaired in less than the allotted time. This would mean that standards would have to be maintained and that any variations from them be kept on record. The method of accounting would have to be changed to take in the advanced machine cost so as to cover classified repairs.

I believe that this would lead to a saving in that it would cost nothing in the way of new equipment, men, etc., but would utilize present facilities to better advantage. Less time in shops means more locomotives in service and reduced cost of repairs.

SCHEDULE SUPERVISOR

Sympathizes with "Top Sergeant"

MICHIGAN

TO THE EDITOR:

"Top Sergeant" submitted an article in your August number that has brought down upon his head the wrath of a majority of the contributors to the "Bill Brown-Top Sergeant" controversy. Sober analysis should mellow the harsh words levelled at him by those who appear to be "sitting pretty." We might be dealing with the finest type of man; competent as a workman, keen, efficient as a supervisor, and a good organizer. With all these able qualities, what would they profit him if his superior, the superintendent of motive power, was of the old school, who had no regard for the men's point of view and who still lived in the glories of his success of yesterday and insisted that his supervisors follow in his wake? This is not far removed from the actual. I have been up against its parallel and sacrificed my position rather than be coerced into doing something my convictions would not permit

The general manager of a plant supervised by the writer was of a type that instead of "Will you do it?" said "You will do it." Each day he would walk through the various departments of the plant taking notes. On Wednesday morning the entire supervisory force was called in for what was termed a conference. The general manager assumed the role of a dictator and no one dared speak his thoughts nor offer any defense of the charges made against him. The individuals were each sought out; the "Big Boss" would walk from behind his desk with fist closed and deliberately shake it while admonishing, abusing and swearing at the one under indictment. I was called in just once and when my turn came the practice was tried on me and the battle was on. I broke up his party and was never again invited to attend. The men, after taking the abuse, would file out, dejected, hateful, resentful and vindictive; for the preservation of their jobs throughout the week they could do but one thing, and they did it. The

plant about which I have just written is industrial and employs some three hundred men.

A superintendent of motive power, passing through a shop, came suddenly upon a foreman reading and at the same time studying an article in a mechanical paper. The article in question contained some valuable information upon a problem the foreman was about to deal with. Explanation of this did not soften the abuse meted out. To his everlasting shame the autocrat, in the course of his discourse, told the foreman in the presence of many of his men that when there was any reading of magazines to be done, he, the superintendent of motive power, would do it, and that the foreman was paid to supervise and do his studying and reading at home. The particular foreman in question was always late leaving the job and was first back to it, so that his home time was spent trying to gather some six or seven hours much needed sleep.

A flash of what I am trying to convey was given you by the "Top Sergeant" when he said: "He would very probably and in my opinion quite justly be canned by our superintendent of motive power as being unfit supervisory material." The superintendent of motive power is as much at fault that men are hard-boiled as any other factor. A man in constant fear of abuse for things he does and does not do cannot meet his problems with a smile. It is too much to expect of any human. Though he may have the ability, the other factors will be concealed in a cloak of indifference and for his self-preservation, the supervisor will proceed to take it out on the other fellow.

I can recall instances, and they are comparatively recent, when any measure short of personal injury would not have been too severe to administer to subdue certain disturbing elements. Labor, the commodity, is human as well as mechanical and is a variable and versatile quantity and as such must be dealt with. One time it is the individual and another it is the whole body. Many conditions must be examined and dealt with. Shop conditions, location, relative availability of work, are factors, and determining ones, on the relation of the men toward their supervisors. If you have a body of intelligent and fair workmen, where little disturbance from within or without is ever encountered, you are fortunate. The "Top Sergeant" may have inherited a body of I. W. Ws, or communists; the "riff-raff of industry, whose sole aim is its domination. This would tax the capacity, tact and ability of a superman and only a hard-boiled supervisor could handle the situation. This condition actually exists on railroads and it takes the iron hand of a disciplinarian to cope with it.

The questions involved in this issue are co-ordinated with the "bread-and-butter" problem, which is the biggest question any government or people are called upon to deal with. The man on the job knows best what measures to apply. When things go along it is dandy to talk and write a story of how easy matters can be handled and adjusted, but bump into the reverse and this same supervisor will change his song story to one of hate. The supervisor is only human. A million petty things, personal and otherwise, inspire men to do some seemingly very unjust things.

A liberal interpretation of the article written by the "Top Sergeant" might give us room to criticize him. He is not a bad man, but human, rather frank, and you must admit he has the courage of his convictions whether you agree with him or not. That he is a reader of technical and mechanical journals is evidenced by the fact he saw the article of "Bill Brown."

The success of dealing with men in any supervisory capacity is the ability of the supervisor to measure up to conditions and situations as they demand. You cannot handle these situations from a book written by someone, somewhere, who has never passed through the fire.

The Chaplain

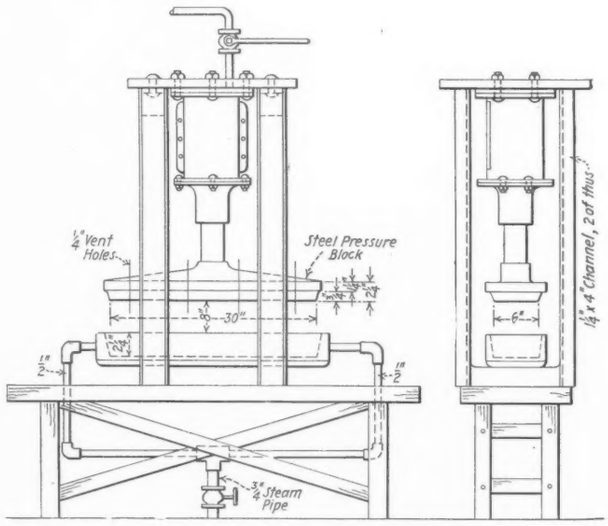
Reclaiming asbestos lagging

Brownwood, Tex.

To the Editor:

Practically every railroad shop in the country attempts to reclaim a part of or all of its asbestos locomotive lagging. Mr. Nygren's question, which was published in the September *Railway Mechanical Engineer*, especially as to the pressure required, should be of interest to many shop foremen. I have had some experience along this line and have had some of the difficulties usually met with in molding.

A device for molding reclaimed asbestos locomotive lagging is shown in the sketch. This sketch is not detailed and is only shown to give the reader an idea to work on and help solve the problem. The device consists



Sketch showing device for molding reclaimed asbestos blocks

essentially of a steam jacketed box for molding and an 8-in. air brake cylinder with a steel pressure block in which is drilled a number of ¼-in. vent holes, attached to the piston. Steam for drying the asbestos block, is piped to the molding box, which is lined with ¼-in. sheet metal. The inside of the box is tapered so as to facilitate the removal of the asbestos block.

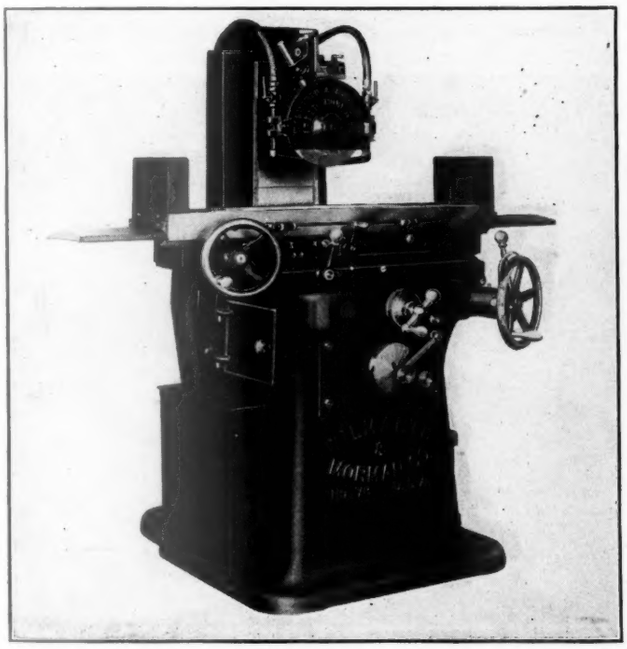
In mixing the mud do not let hard bits enter the mold and do not use too much water. Fill the box full of the asbestos mud and then press to form the block. By having two or three different thicknesses of pressure plates, say one each of ¾ in., 1 in. and 1¼ in., you can obtain as many block sizes. This device can also be built to make more than one block at a time.

A Reader.

The Chicago & North Western is making a series of tests of oil-electric locomotives in switching service in its freight yards in Chicago. Both the locomotives built jointly by the Ingersoll-Rand Company, the American Locomotive Company, and the General Electric Company and the Diesel type, developed by the Baldwin Locomotive Works and the Westinghouse Electric & Manufacturing Company, are being tested. The North Western also has purchased two rail motor coaches for use in branch line passenger service.

Surface grinder with motor mounted in the base

SEVERAL improvements have recently been incorporated in the construction of the No. 78 surface grinder built by the Wilmarth & Morman Company, Grand Rapids, Mich. Ready access to the various mechanisms, a drive that is mounted on ball bearings, a flexible coupling from the motor, a ball bearing

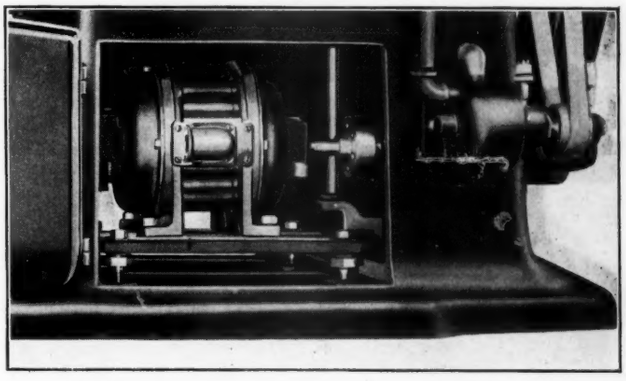


All operating control levers on the Wilmarth & Morman No. 78 surface grinder are easily accessible to the operator

clutch, ball and roller bearings in place of bronze, a patented spindle with positive take-up and direct flow of coolant from the saddle to the coolant tank are features of the machine illustrated.

As in the original machine, the controls have been located for the convenience of the operator. The elevating hand wheel is geared so the divisions on its dial are 5/32 in. apart, but register 0.0005 in. between divisions. This wheel is located at the right while the longitudinal table-feed handwheel is at the left side. There is a graduated cross-feed ball-crank handle, an automatic cross-feed throwout lever, with adjustable dogs to set for a desired width of grinding, and a longitudinal table starting and stopping lever for use in automatically transferring the table feed from power to hand operation. Clutches are used in this last named control so that the change is positive from one feed drive to the other. Feed at one or both ends of the stroke can be selected by turning a knurled knob near the center of the machine.

The spindle rides in deep-groove type ball bearings and is arranged to take up lost motion automatically. A hand-



The motor, mounted in the base compartment

adjustable take-up is also included. All of the bearings are protected against the entrance of dust and grit.

The hardened steel clutch for use in reversing the table travel, is mounted on ball bearings on a hardened shaft, the balls acting as a driving key between shaft and clutch. This arrangement has been made to result in free action of the clutch and to eliminate jar at the point of table-travel reverse. The clutch is said not to slip prematurely or to stop on center.

The grinding wheel head travels vertically on flat ways located on the front and rear of the upright housing and between tapered ways within the housing. A take-up is provided at the rear of the wheel head and is designed for sensitive manipulation. There are two head-elevating screws with right and left-hand Acme threads arranged to work in unison. They are mounted in adjustable

bronze nuts which serve to compensate for lost motion in the elevating mechanism.

The table is mounted on two ways, one flat and one tapered, and is driven by means of a spiral rack and pinion. There is ample spread between the ways to insure steadiness in the arrangement.

In the saddle mechanisms and controls, simplicity has been featured. Large openings have been provided in this part of the machine to allow for free flow of the coolant from the saddle to the coolant tank. Sliding, telescoping dust guards protect the parts.

The main frame is a one-piece casting. This frame is provided with openings, to permit of access to all of the mechanisms within, including the gear box, the worm-feed gear and the automatic mechanism. This arrangement makes it unnecessary to lift the saddle or the table to get at these parts. The gear box contains the reversing gears that are driven by the ball-bearing clutch described.

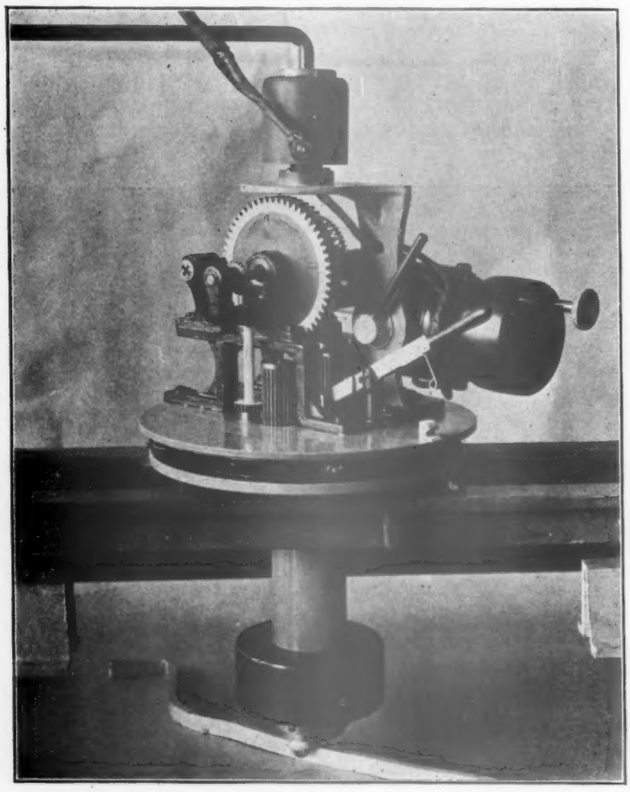
The machine can be arranged to be driven by a motor located inside the base. A 1½-hp., 1,200-r.p.m. motor is recommended for this service. A door, on each side of the base, makes the motor fully accessible and simplifies the problem of caring for it properly. The motor compartment is separated from the upper chamber containing the driving mechanism, connection from motor to drive being supplied through a ball-bearing drive shaft and a flexible coupling.

The machine is regularly furnished for wet grinding, the coolant being piped to both sides of the wheel to insure complete flooding of the work as it enters and leaves the wheel. The pump and piping are built into the machine.

The machine occupies a floor space of 44 in. by 86 in. and weighs 2,300 lb. net.

Gas automatic shape cutting machines

AN automatic gas cutting machine designed to cut out of the solid such locomotive part as frames, side and main rods, links etc., has been placed on the market by the Automatic Cutting Machine Company, 66 Brookline avenue, Boston, Mass. The machine is completely automatic in its operation, as it runs on



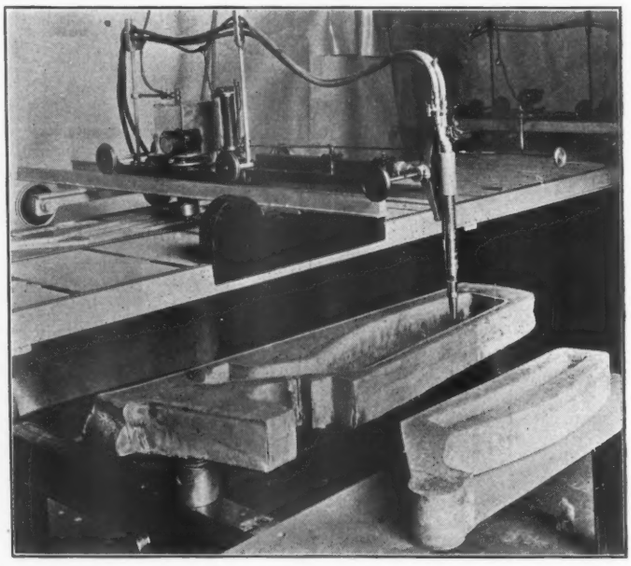
The driving mechanism, mounted on a turntable, easily follows any change of direction

two rails and the torch is guided by an aluminum template.

A table for the template is located on one side of the machine, while on the front side is the bed for holding the work. The piece to be cut is placed on the bed inside of the cutting range. The template is shifted to suit the path of the intended cut. The operator stands in front of the torch, manipulates the torch valves and adjusts the speed with a hand wheel. A rheostat allows the finest speed variations. With another hand wheel, the operator can raise or lower the torch to follow any surface irregularities of the work. Every adjustment is within his reach.

The machine proper has two perpendicular movements, both mounted on ball bearings and wheels instead of on slides. Thus, a few ounces of pull moves it anywhere.

The torch and tracer are rigidly connected and there



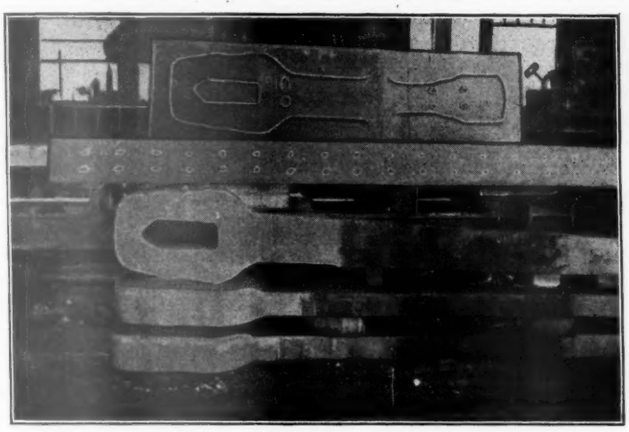
Automatic shape cutting machine cutting out Walschaert links

are no linkages in any part of the machine. Thus the reproduction does not suffer from loose joints or play in the bearings, which mar the exactness of the cut in proportion to the play in the joints.

The driving mechanism is mounted on a turntable which easily follows any change of direction without any side thrust. It imparts its movements to two sharp toothed cones located at the lower end of a well-centered floating tube. The two cones straddle an inexpensive aluminum strip, 7/16 in. high and ¼ in. wide, which is easily bent and rebent by hand into any desired shape. A weight presses the floating tube with the two straddling

cones tightly against the aluminum strip. When rotating, the two cones move the machine exactly over the course of the shape of the aluminum strip, and the torch moves in an exactly parallel course.

The relative rotating speed of the two cones, driven by a well-centered and balanced differential which eliminates any set thrusts, varies automatically. One cone can stop, as for instance in sharp corners, while the other cone swings around at full speed.



Locomotive main rods and template

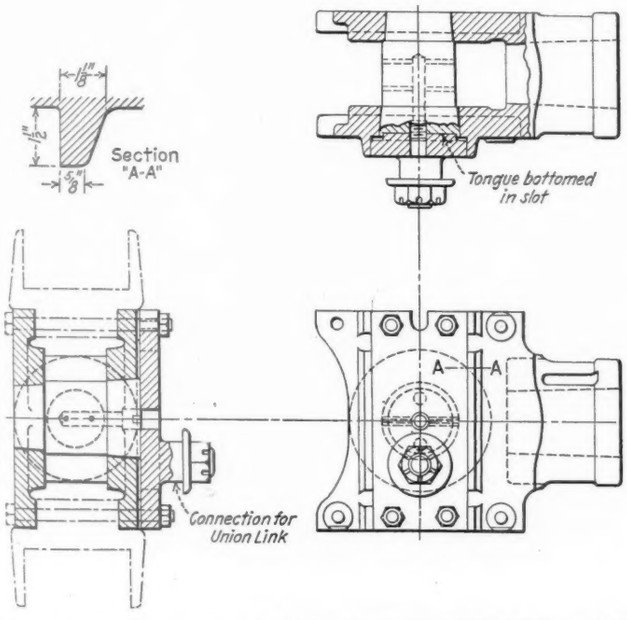
The torch traveling mechanism is driven by a small universal electric motor of about 1/75 hp., which drives a worm wheel on a pinion shaft. This, in turn, drives a gear wheel which is fitted with a differential system. Through this differential ends of the two vertical shafts are driven by bevel gears and these shafts drive the cone shafts through a pair of long idlers, which permit the floating tube containing the cone shafts to be lifted from the template without disengaging the gears. For the speed variations a rheostat is used with a long rod and handle reaching to a place near the torch. Furthermore, the driving motor is swivelled so as to allow the insertion of small or larger worm gears. In this way major speed variations can be obtained, which is an important feature in obtaining maximum production.

A template once made will always reproduce the same shape for worn bearings. The aluminum strips can be bent by hand and then spiked on a wooden board for one-time cuts, or riveted on a 1/8 in. steel plate for repetition work.

The floating drive is not a support, and no nearby forge hammers or other vibrations affect the machine. The floating drive will set in place to the template and not jump off the template.

Hubbard crosshead developed on Rock Island

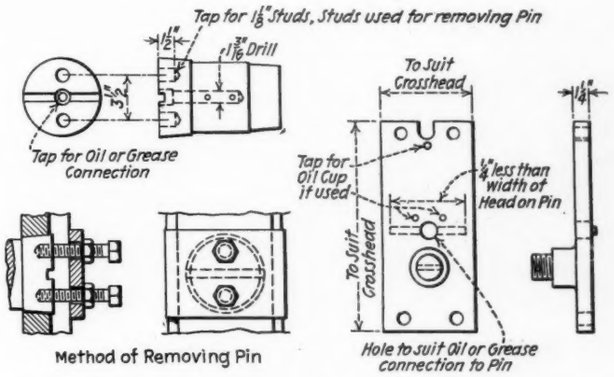
THE Hubbard crosshead illustrated and described in this article originated on the Chicago, Rock Island & Pacific and has been used successfully for about two years on that road, being specified on the last few lots of new locomotives and applied in case of renewals. Perhaps the two most prominent features of the new crosshead are first, the arrangement for applying and removing the wrist pin from the outside; and second, the provision of lugs cast on the face of the crosshead to relieve the crosshead bolts of practically all shear.



General arrangement of the Hubbard crosshead used on the Chicago, Rock Island & Pacific

The wrist pin of the crosshead is applied or removed from the outside and cannot turn in the crosshead fit as a slot across the outside end is engaged by a tongue on the keeper plate. The keeper plate cannot turn as it is secured by two top and two bottom gib bolts, and the shear is taken off these bolts by lugs cast on the outside wing or cheek of the crosshead. Washers between the keeper and plate of the crosshead body give a metal to metal bearing throughout the entire length of the gib bolts.

This design saves time in enginehouses as it is not necessary to spot the engine to remove the wrist pin. Heavy modern locomotives are difficult to spot by pinching and in some cases it is impossible to get enough bars to the wheels to move them. To wait for the hostler to bring around a hot engine means many valuable minutes lost to the mechanic, and adds to the time required to turn the engine. Not only is this crosshead designed to reduce enginehouse turning time and facilitate making


Tap for 1⅛" Studs, Studs used for removing Pin
1½" Drill
To Suit Crosshead
Tap for Oil or Grease Connection
Tap for Oil Cup if used
¼" less than width of Head on Pin
To Suit Crosshead
Method of Removing Pin
Hole to suit Oil or Grease connection to Pin

Details of Hubbard crosshead arrangement—Method of removing the pin

running repairs, but in case of a breakdown on the road where it is necessary to take down the main rods, this can be done at once by the engine crew, again without waiting for help to spot the engine.

The design of the Hubbard crosshead is such that the wrist pin cannot work in as is often the case where nuts have worked off the ordinary style of wrist pin or when the end of the pin breaks with the nut and cotter key intact. The wrist pins for the new crosshead are fitted with draw, and have the tongue on the keeper plate bottom in the slot in the end of the wrist pin. The washers at the gib bolts in the end of the keeper plate are then made the necessary thickness to give a slight spring to the plate, thus keeping a substantial pressure on the wrist pin.

The union link trunnion is shown slightly below the wrist pin center, this arrangement permitting center lubrication of the wrist pin. The trunnion may be central over the pin, or the keeper plate may be of cast steel and extended down and out to meet any present location of the union link.

This crosshead, which is made by the Hubbard Steel Foundry Company, Chicago, can be altered in design to take care of any design of crosshead including the Laird type. Ordinarily the alligator type crosshead can be changed by simply adding the lugs which hold the keeper plate to the present pattern. Both right and left crossheads can then be machined on the same pattern. It is customary for the railroad to make the wrist pin and keeper plate but the manufacturer furnishes them to the railroad's blue prints if required. The crosshead fits are maintained practically standard for the life of the crosshead, it not being necessary to build up these fits and rebore them. This eliminates the necessity of welding which may set up stresses, sufficient to develop checks and cause subsequent crosshead failures.

Locomotive frame jaw grinder

A DEVICE known as the Sheldon locomotive frame jaw grinder has been developed and placed on the market recently by Manning, Maxwell & Moore, Inc., New York. As shown in the illustrations, this device is a portable tool, adapted to various re-surfacing operations in railroad shop work. The grinding wheel is driven by a direct-connected pneumatic turbine-type motor, mounted on standard radial ball bearings and lubricated by the Alemite system. The motor is designed with ample power to pull a six-inch face course grain grinding wheel when held firmly against a six-inch surface. The body of the tool, made from one piece of three-inch tubing about 15 in. long to assure accurate alinement of rotating parts, is so constructed that it covers one side of the grinding wheel affording ample protection.

The Sheldon grinder saves time in straightening worn frame jaws

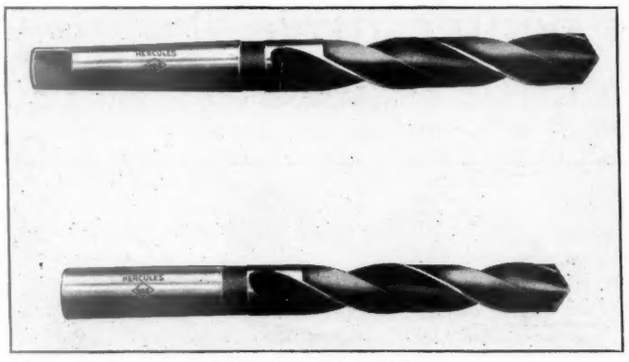
The Sheldon grinder is simple in design, compact and accurately balanced. It is built for hard service, and maintenance costs should be negligible as there are no connecting rods or reciprocating parts to burn up or become loose. The tool is particularly designed to expedite re-surfacing jobs such as the squaring and straightening of locomotive frame jaws, preliminary to the application of new shoes and wedges. Under the action of wear, these jaws present a highly polished and almost case-hardened surface usually worn at least 1/32 in. out of true in locomotives which have made their mileage. Hand filing of these frame jaws is a slow and expensive operation and the Sheldon grinder with wide face wheels expedites this work. In addition, re-surfacing jobs on rod straps are said to be handled with this tool with a considerable saving over hand finishing methods. Most rod straps are an-

Sheldon portable pneumatic grinder in use on main rod back end strap

nealed at each shopping of the locomotive, and, in cooling, a surface scale forms which clogs the files and greatly retards hand finishing work. The Sheldon grinder is designed to save time, labor and file expense in grinding and polishing main and side rods and many other re-surfacing operations.

High speed tapered and straight shanked drill

THE original Hercules No. 550 high speed twist drill, was made with a hub at the large end of the shank. This was done to give additional strength to the already oversized shank to better permit driving a powerful tool. For certain jig work and in multiple spindle drill presses, this hub was, however, sometimes objectionable. The Whitman & Barnes Manufacturing Company, Akron, Ohio, has developed a new process of making shanks, doing away with the hub and permitting the new No. 555 drill to be used wherever a standard drill may be used. The drill is now made also in the straight shank which is designated by the manufacturer as the No. 444.



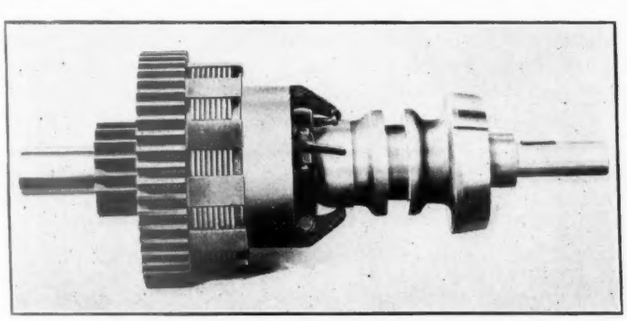
Hercules twist drills

This manufacturer has standardized and simplified its line of drills. Overall and flute dimensions correspond, size for size throughout the Hercules drills. In the carbon taper and straight shank tools the dimensions are made to correspond with the counterparts in the high speed drills. The new Hercules No. 555 and 440 have eliminated the old Hercules No. 550 and 500 as well as the Diamond drills No. 402 and 402-SP and No. 404. The purchaser may, therefore, select from a list of two drills, one taper and one straight shank, as against five drills heretofore.

Improvements made to milling machine

POWER rapid traverse to the table of all models of machines larger than the No. 1 and No. 2 S sizes, multiple disc friction clutch, an adjustable starting lever, centralized oiling for saddle and table, and independent table feed control are the new features added to the line of Milwaukee milling machines manufactured by the Kearney & Trecker Corporation, Milwaukee, Wis.

Power rapid traverse of the table is controlled by the long lever shown on the right-hand side of the knee.

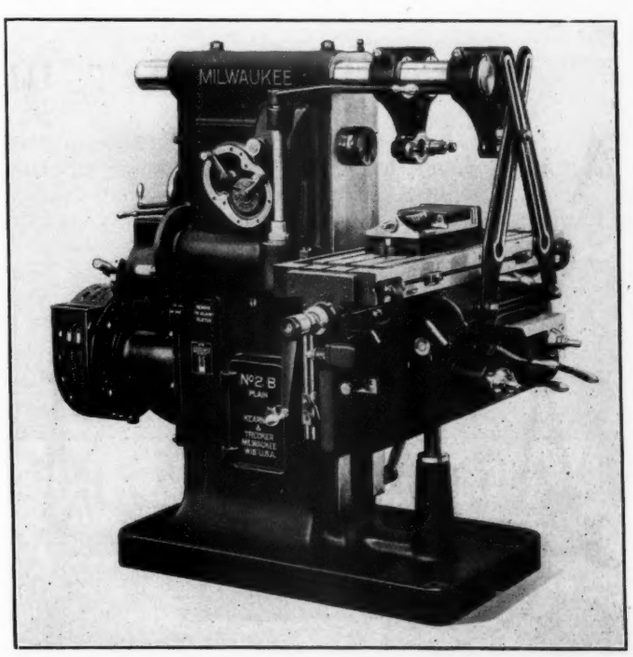


Multiple disc friction clutch which operates continuously under full load

Raising this lever causes the table to travel at the rate of 100 in. per min. in the same direction in which the table power feed is engaged. When the operator lets go of the lever, the normal table feed is again resumed.

The new multiple disc clutch, shown in one of the illustrations, is said to work continuously under full load and to be smooth and positive in operation. The discs are amply separated when disengaged, eliminating all tendencies to drift and a cone type brake is provided for quickly stopping the spindle. Tools are not required for adjusting and the pin adjustment provided is said to permit of quick adjustment that is uniform over the entire frictional area.

The new adjustable starting lever, which operates the friction clutch, extends to the front of the machine on the left side of the double overarms. This lever may



Redesigned Kearney & Trecker milling machine, showing the starting lever which operates the multiple disc friction clutch

be adjusted to any angle to suit the convenience of the operator, or swung completely out of the way to accommodate large work.

Centralized table feed control is accomplished by a single lever directly at the front of the table, this lever engaging the automatic longitudinal feed in a direction in which it is moved. The action is independent of either the cross or vertical feeds. This is stressed as making for faster operation, as the table feed is the one most frequently engaged.

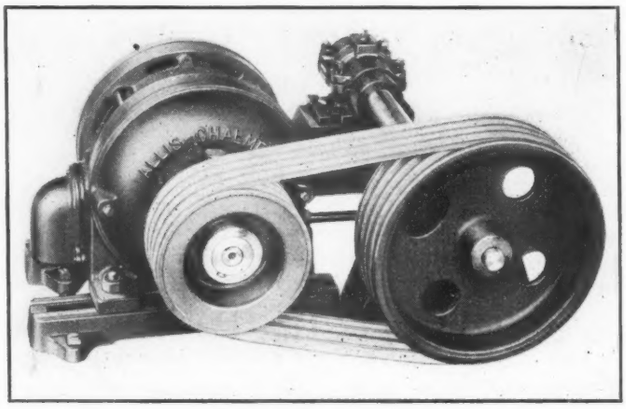
At the front of the saddle on the right-hand side, there is an oil reservoir fitted with tubing which leads to all of the important wearing surfaces in the table and saddle. Prominent location of this reservoir is intended to eliminate all possibility of the operator's failing to lubricate properly any of the vital parts of the saddle mechanism. This new feature, together with automatic flood lubrication for all gears and bearings inside of the column, practically concentrates oiling at but two filling points. All models and sizes, Nos. 1 to 4, of the company's milling machines are now available with enclosed motor-in-base drive.

A flexible short center drive

A NEW type of short center, flexible drive, known as the Texrope drive has recently been placed on the market by the Allis-Chalmers Manufacturing Company, Milwaukee, Wis. It can be used on machine tools, fans and blowers, conveyors, etc.

The drive consists of two grooved sheaves and a number of specially constructed endless vee belts. The sheaves are set just far enough apart so that the belts fit the grooves without either tension or slack. Since the Texrope belts just fit the sheaves, there is no appreciable slack or lost motion in the drive. Because of the vee construction, the belts cannot slip, as the harder the pull the more firmly the belts grip the grooves. As the belts are elastic they act as cushions between the driving and driven machines and do not transmit vibrations. Bearing pressures are low, since no initial belt tension is employed. The drive occupies very little space. It is silent, clean and is said to be unaffected by moisture or dirt. Since there is no appreciable slip, the speed ratios are constant.

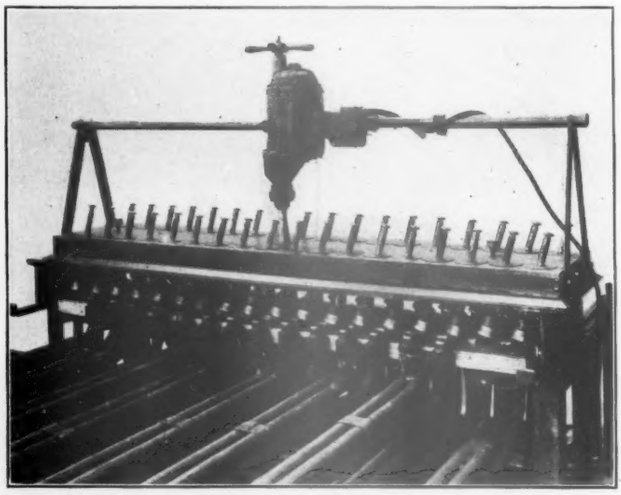
Texrope drives from ½ to 250 hp., with ratios up to 7 to 1 and belt speeds from 800 to 6,000 feet have already been placed in service.



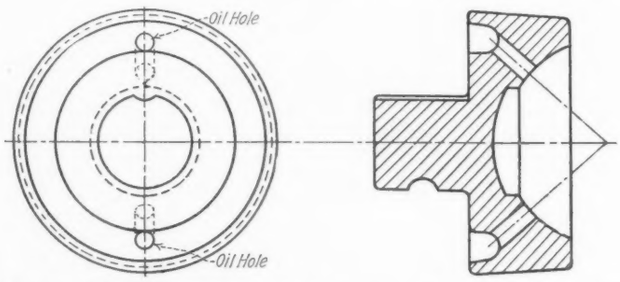
An exhibition model of the Allis Texrope drive manufactured by the Allis-Chalmers Manufacturing Company

Superheater unit joint grinder

A MULTIPLE spindle tool designed to grind two rows of superheater unit joints, totalling as many as 36 joints, simultaneously, has been developed at the Beech Grove shops of the Big Four and placed on the market by the Transportation Devices Corporation, Indianapolis, Ind. The construction of the tool will be evident from an examination of the illustrations which show a front view of the machine in operation and also with the grinding spindles lifted and the machine head rolled back for inspection of the joints. The spindles, all driven through enclosed gears from one motor, have a gyratory movement, and one of the important advantages of the tool is that this movement is more uniform and hence tends to produce a more uniformly satisfactory joint than one ground by hand. A bad fitting joint is



Front view of the superheater unit joint grinder grinding 36 ball joints at one time

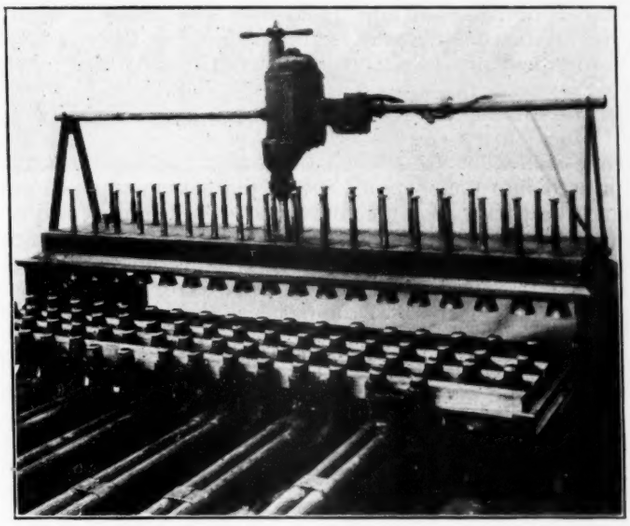


The special grinding lap head has a recess at the top of the cup and an annular groove with two feed holes to the grinding surface

difficult to repair after the superheater is applied to the locomotive.

Special grinding lap heads are provided with a recess at the apex of each cup which prevents bottoming on the joint. This construction also tends to maintain the correct contour, thereby prolonging the life of the lap head. Grinding compound is placed in an annular groove on the top of each lap head, feeding automatically through two holes to the inside grinding surface. It is not necessary to stop the machine to apply grinding compound to the annular grooves or lift the lap heads, for the compound to feed to the surfaces being ground. The machine is therefore automatic in operation requiring only an occasional inspection after the set-up to determine when the joints have been ground sufficiently. This feature is important in obtaining efficient production.

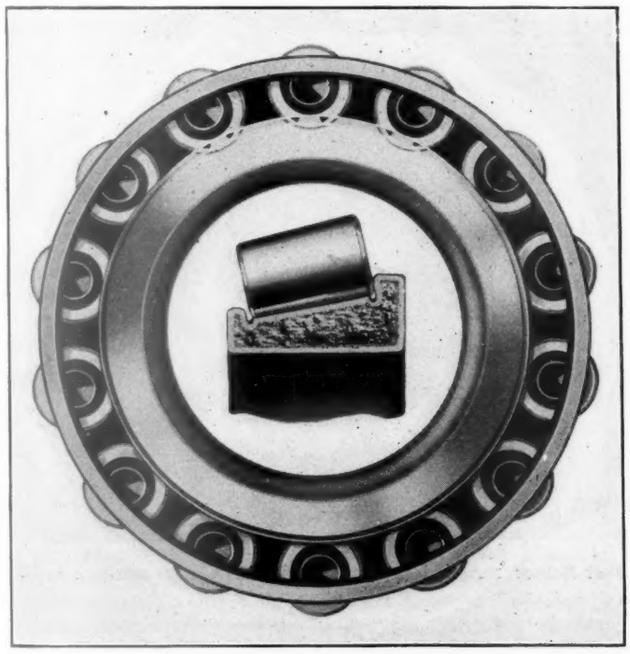
In operation the superheater units are given necessary repairs and assembled in the grinder in the same relative positions as occupied in the locomotive. No bolts or clamping devices are necessary to hold the units, their weight being sufficient to keep them in place. The only supporting equipment required consists of metallic longitudinal spacers built into the machine, and wooden cross spacers to maintain the proper center distances. When the grinding operation is completed the entire set of units is lifted out of the grinder by a crane and delivered to the desired location in the shop, thus eliminating considerable extra handling.



Grinding spindles lifted and the machine head rolled back for inspection of the joints

Improved tapered Timken roller bearings

AN improved type of Timken tapered roller bearing, differing from the older type in major refinements but retaining all the original essential elements, has recently been placed on the market by the Timken Roller Bearing Company, Canton, Ohio. These bearings

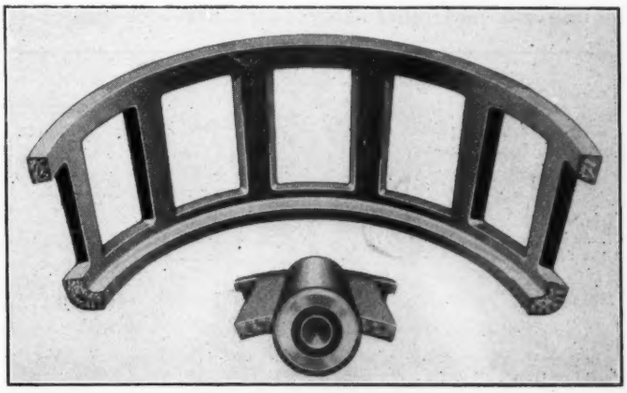


The bearing between the end of the Timken roller and the cone flange is in two areas, shown in phantom at the top of the illustration

are particularly adapted to rail and motor truck service.

Nickel-molybdenum steel, of special Timken formula has been adopted for all bearings. The inclusion of nickel and molybdenum produces a steel possessing properties of grain texture, toughness, hardening, heat treating and machining which tend to increase the life of antifriction bearings.

Varied refinements in the bearing itself are noteworthy. The design of the roll has been changed so that the surface of the large end presents a right angle relation to the center line of the roll. The contact between



Improved Timken roller cage showing inwardly turned flange which prevents stretching of metal when stamping out bearing pockets

the large end of the roll and the rib of the cone is in two areas. The rib of the cone is slightly undercut. This two-area contact insures perfect axial alinement between the center line of the roll and the center line of the bearing at all times. Likewise, there is always absolute line contact between the surface of the roll and the surface of the cone, and between the surface of the roll and the surface of the cup.

An added purpose served by the two-area contact is self-alinement of the rolls on the cone in the cup without

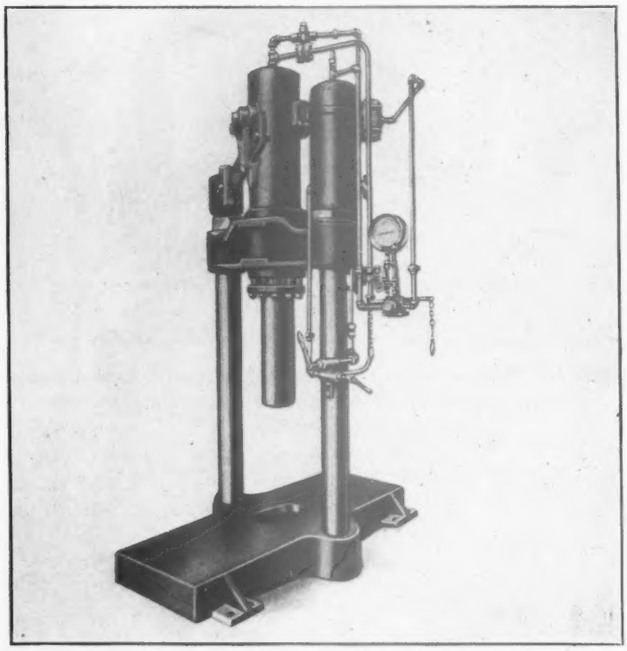
resorting to a cage fixture to retain the alinement. The primary purpose served by the cage is to retain the spacing of the rolls about the cone and to make the cone with its set of rollers a unit assembly. The skewing of the roll on the cone raceway is impossible, since the two areas on the end of the roll make generously separated points of contact with the shoulder or rib of the cone, as shown in the illustration.

The Timken cage has been improved along with the cone and roller assembly. Previously, the cage was cold pressed into the shape of a cup, the bottom stamped out and the pockets for the rolls punched out, one at a time, by an automatic punch press. The result of this single stamping operation was positive uniformity of cage pockets, but there was a progressive error in alinement, due to the stretching of the metal as the indexing fixture advanced the metal cage to the final perforation. To correct this microscopic error, a multiple perforating die was developed which perforates all roll pockets in the cage, by a single impact. To further safeguard against any possibility of error due to distortion during this operation an inwardly turned flange has been retained on the smaller side of the cage. To insure smoothness and a perfect fit of the rollers in the cage, the lateral edges of the cage are swedged inward so that the contour of the sides of the cage pocket conform to the contour of the roll. Dies similar to the multiple perforator are used, so that all cage pockets are winged simultaneously. The inwardly turned flange and the result of the winging operation are shown in the illustration.

With the advent of more quietly running parts in certain machine installations, the Timken Company has kept pace by reducing the noise in the bearing to a marked degree by the self-alining principle and perforated cage.

Two rod hydro-pneumatic forcing press

A PRESS designed for operations involving forcing, pressing and bending, and adaptable more especially to railroads and other large shops has been placed on the market by the Watson-Stillman Company, New York. This press not only provides means for the rapid and convenient pressing in and out of bushings, driving box brasses and pressing of gears on and off of shafts, but because of its long bottom platen or base it can be used for many operations of bending and straightening.



Watson-Stillman hydro-pneumatic 100-ton capacity forcing press

The press is of the two rod type having the ram movement from the top downward. The ram movement is actuated by hydro-pneumatic force obtained by an air engine pump which is designed to be connected to the air line of the shop. Thus, it will be seen that the press can be operated in any shop having air pressure and does not require a motor or any other source of power.

A jib crane is provided as part of the press to facilitate handling work into and out of the press. The bottom platen is amply strong for bending with blocks on its ends up to the full capacity of the press.

The valve control is simple and easily operated and a gage is provided to register in tons the pressure exerted by the ram. The press illustrated is of 100 tons capacity and bottom platen is 72 in. long with a hole in the center to receive shafts, etc.

Unit heater for railroad shops

THE unit heater recently developed by the ILG Electrical Ventilating Company, Chicago, is a cabinet open at both ends in which is housed heating coils for steam or hot water and a self cooled motor propelled fan. This cabinet serves as a heating chamber for the air which is drawn in over the heated coils on the intake side at low velocity—about 500 ft. per minute and discharged in volume at high velocity at about 200 ft. per minute. The heaters are intended for shops, factories and warehouses and similar localities and it is claimed for them that they effect a considerable saving in fuel as well as greater rapidity in warming up the buildings.

Unit heater installed in New York Central locomotive repair shop

PROMOTIONS AND APPOINTMENTS I.C.C. THE SUPPLY TRADE

News of the Month

CLUB AND ASSOCIATION NEWS NEW TRADE PUBLICATIONS NEW SHOPS

THE CHICAGO, BURLINGTON & QUINCY is now using its new Denver shops for the repair of all its locomotives used in Colorado, Montana, Wyoming and western Nebraska. Heretofore this work has been done at Havelock, Neb. The force, when the arrangements are complete, will call for 300 additional men, the present number employed being 700. All repair work for the Colorado & Southern is also being done in this shop.

THE NEW LOCOMOTIVE REPAIR SHOPS of the Mobile & Ohio at Jackson, Tennessee, known as the "Iselin Shops," were formally opened by Fairfax Harrison, president, and E. E. Norris, vice-president of the road, on December 1, 1925. These shops were built by Dwight P. Robinson & Company and consist of a main locomotive repair shop of the transverse type, having fifteen pits; a storehouse and office building; and, in addition, a wheel shop and a power house.

American Railway Association elects new directors

J. M. Davis, president of the Delaware, Lackawanna & Western Railroad, has been elected a member of the board of directors of the American Railway Association, to succeed W. H. Truesdale, chairman of the board of managers of that company, resigned. Fairfax Harrison, president of the Southern Railway System, has been elected to fill the vacancy caused by the death of Julius Kruttschnitt, chairman, executive committee, Southern Pacific Company.

New cars and locomotives

Class I railroads during the first eleven months of 1925 placed in service 123,858 freight cars, according to reports filed with the car service division of the American Railway Association. This was 24,973 cars less than the number installed during the corresponding period of 1924 and 53,987 less than during the same period in 1923. The total placed in service in November was 4,615, including 1,726 box, 1,975 coal and 395 refrigerator cars. Freight cars on order on December 1 totaled 27,721, as compared with 45,095 on the same date in 1924 and 36,789 in 1923.

Class I railroads during the first eleven months in 1925 placed in service, 1,604 steam locomotives, compared with 1,951 during the same period in 1924 and 3,704 during the corresponding period in 1923. The same roads on December 1 had 339 locomotives on order, compared with 265 on the same date in 1924 and 739 two years ago. During the month of November 112 locomotives were installed in service.

These figures as to freight cars and locomotives include new, rebuilt and leased equipment.

Mechanical division adopts standard double sheathed wood sheathed box cars

Two designs of double sheathed, wood sheathed standard box cars presented at the annual meeting of the Mechanical division of the American Railway Association by the Committee on Car Construction have been submitted to letter ballot and adopted by an overwhelming majority of the membership. Members numbering 313 and representing 2,450,755 cars owned or controlled, voted in favor of the proposed standard designs, with seven members representing 46,830 cars opposing, and 89 members representing 250,452 cars not voting. The results of this letter ballot are given in Circular D. V.-434. In addition to the adoption of standard car designs, the association has approved as recommended practice specifications for side frames and bolsters, coupler yokes and hatch plugs for refrigerator cars as recommended by the committee. The minimum wheel seat diameter of axle with 4½-in. by 8-in. journals is increased to 5¾ in., and the total load for car and lading established at 116,000 lb., this change requiring an amendment to the Interchange Rules of the Division which is approved, effective January 1, 1926. The proposition to withdraw the present bolster drawings shown in the manual and substitute the new bolsters shown with the standard car drawings is approved, effective March 1, 1926.

The results of five other letter ballots recently submitted to members of the Mechanical division have been tabulated and published in Circulars D. V.-429, relating to brakes and brake equipment; D. V.-430, couplers; D. V.-431, specifications for tests for materials; D. V.-432, wheels; and D. V.-433, loading rules. In each case the recommendations of the committees in their reports at the June meeting at Chicago were adopted by large majorities.

A. R. A. purchases Williams' car patent

The American Railway Association has acquired the rights to the patent of William Erastus Williams, No. 1,237,434, dated August 21, 1917, which, among other things, covers car roof construction involving the use of a Z-bar side plate so arranged that the Z-bar, in addition to being a connection between the roof and side members of the car, forms a part of the water shedding surface of the roof. In its Circular No. 2569, dated December 1, the association states that "All railroads in the United States and

Arrangement of z-bar side plate and roof

all railroads in Canada and Mexico having lines running into the United States, car owners operating in the United States, and car manufacturing companies may use the construction covered by this patent free from any royalty or payment of any kind."

The patent is held by H. J. Forster, secretary of the association, as trustee for the benefit of the American Railway Association.

Hearing on "Recurrent Acknowledgment" requirement of train control specifications

A hearing was held before Examiner Mullen of the Interstate Commerce Commission at Washington on December 14, with respect to the interpretation placed by Division 1 of the commission upon paragraph 2b, under "Functions" of the specifications and requirements for automatic train-stop or train-control devices. The interpretation, which several of the roads have asked the commission to withdraw, is that "Consistent practice requires definite action by the engineman at each signal indicating stop." W. M. Jeffers, general manager of the Union Pacific, said that operating officers do not feel that the additional requirement of recurrent acknowledgment is necessary and they do feel that it is to some extent objectionable. He said he feared there is a disposition to go too far in assuming that the engineman is not going to be alert, and that the biggest mistake the commission or the railroads could make would be to "get the enginemen in a frame of mind to expect that a device is going to take care of them." A. H. McKeen, signal engineer of the Union Pacific, gave more detailed testimony. J. E. Saunders, signal engineer of the Delaware, Lackawanna &

Western, and H. H. Shepard, general superintendent of that road, also testified. Other roads which have installed or are now installing the Union Switch & Signal Company's device, similar to that on the Union Pacific, asked leave to adopt the testimony without introducing additional cumulative evidence.

Labor Union co-operation

An unusual type of meeting will be held in the auditorium of the Engineering Societies Building in New York City on Friday, February 5, at 8:15 p. m. A joint meeting of the Taylor Society and of the Metropolitan Section and Management Division of the American Society of Mechanical Engineers, with the New York Railroad Club co-operating, will consider "The Labor Union—Management Co-operation in the Railway Industry. A Case Presentation of Effort Towards Stabilization."

Otto S. Beyer, Jr., consulting engineer, widely known as the adviser to the shop crafts labor unions on the Baltimore & Ohio and the Canadian National Railways, will speak on "The Technique of Co-operation." Bird M. Jewell, president of the Railway Employees' Department of the American Federation of Labor, will address the meeting on "Labor's Appraisal of Principles, Methods and Results." Sir Henry Worth Thornton, chairman of the board of directors and president of the Canadian National Railways, will make an address on "Management's Appraisal of Principles, Methods and Results."

Many equipment orders placed for 1926

The Pacific Fruit Express Company has been authorized by its owner companies, the Southern Pacific and the Union Pacific, to purchase 5,000 refrigerator cars to be delivered before September 1, 1926, and in addition to build 41 cars to replace cars retired from service during the past year. The acquisition of this number of additional units will make available for the Pacific Fruit Express 38,375 refrigerator cars, an increase of 15 per cent. The purchase entails an additional investment of almost $16,000,000.

The Baltimore & Ohio has ordered 25 Santa Fe type locomotives from the Lima Locomotive Works, and 25 Santa Fe type from the Baldwin Locomotive Works.

The Atlantic Coast Line has ordered 300 hopper cars and 525 box cars from the Pressed Steel Car Company; 100 ballast cars from the Virginia Bridge & Iron Company; and 30 express cars, 25 coaches, 10 combination passenger and baggage cars, 5 combination baggage and mail cars, and 2 postal cars from the Pullman Car & Manufacturing Corp.

The Delaware, Lackawanna & Western has ordered 35 express cars from the American Car & Foundry Company, and 50 ballast cars from the Rodger Ballast Car Company.

The Lehigh Valley has ordered 500 steel sheathed automobile box cars of 50 tons' capacity from the American Car & Foundry Company; 500 steel hopper cars of 70 tons' capacity and 100 drop end gondola cars of 70 tons' capacity, from the Bethlehem Steel Company.

The Louisville & Nashville has ordered 1,000 gondola cars of 50 tons' capacity from the Pressed Steel Car Company.

The Chicago & Northwestern has ordered 250 Hart improved ballast and work cars from the Rodger Ballast Car Company.

The Seaboard Air Line has ordered 40 Mikado and 10 Mountain type locomotives from the Baldwin Locomotive Works.

The Long Island has ordered 20 steel suburban coaches for steam line service from the American Car & Foundry Company.

The Norfolk & Western has ordered 43 all-steel passenger train cars from the Bethlehem Shipbuilding Corporation.

The New York, New Haven & Hartford has ordered 6 dining cars from the Pullman Car & Manufacturing Corporation, and 5 73-ft. combination passenger and baggage gas-electric cars from the J. G. Brill Company.

The St. Louis-San Francisco has ordered 10 Mountain type and 15 Mikado type locomotives from the Baldwin Locomotive Works.

The Wabash has ordered 1,000 automobile box cars from the American Car & Foundry Company, 300 from the Streator Car Company, and 700 from the Standard Steel Car Company; 20 baggage cars from the American Car & Foundry Company, and 25 eight-wheel switching locomotives from the Lima Locomotive Works.

The Atchison, Topeka & Santa Fe has ordered 850 general service gondola cars from the American Car & Foundry Company; 500 furniture cars from the Pullman Car & Manufacturing Corporation; 500 box cars from the General American Car Company; 500 refrigerator cars from the American Car & Foundry Company; 500 refrigerator cars from the Pullman Car & Manufacturing Corporation, and 15 Santa Fe type locomotives from the Baldwin Locomotive Works.

The Erie has ordered 6 through line coaches and 50 suburban coaches from the Standard Steel Car Company.

The North Western Refrigerator Line has ordered 200 refrigerator cars of 40 tons' capacity from the American Car & Foundry Company.

The Reading has ordered 500 gondola cars of 70 tons' capacity from the Bethlehem Steel Company, 250 from the Pressed Steel Car Company, and 250 from the Standard Steel Car Company.

The Illinois Central has ordered 400 automobile cars from the American Car & Foundry Co. and 400 from the Pullman Car & Manufacturing Co.

The Union Refrigerator Transit Company has ordered 400 refrigerator cars from the American Car & Foundry Company and will build 200 refrigerator cars in its own shops.

The Conley Tank Car Company has ordered 200 tank cars from the American Car & Foundry Company.

The Pittsburgh & West Virginia has ordered 400 steel and 300 composite gondola cars from the Pressed Steel Car Company and 300 gondola cars from the Canton Car Company.

The Missouri Pacific has ordered 15 eight-wheel switching locomotives from the Lima Locomotive Works; and 5 Pacific type and 10 Mikado type locomotives for service on the International-Great Northern and the Gulf Coast Lines, from the American Locomotive Company. The Pacific type locomotives will have 27-in. by 28-in. cylinders, and a total weight in working order of 301,000 lb., and the Mikado type locomotives will have 27-in. by 32-in. cylinders, and a total weight in working order of 340,000 lb.

The Kansas City, Mexico & Orient will construct 50 box cars in its own shops.

New York Central places large orders for new equipment

The New York Central has placed orders for the following new equipment, to cost approximately $11,500,000:

Locomotives

American Locomotive Company:
- 10 Electric for service in New York territory.
- 1 Diesel-electric engine* for passenger service McIntosh & Seymour Corporation.
- 1 Diesel-electric engine* for freight service.

Freight Cars

Standard Steel Car Company:
- 500 Automobile box, 55 tons' capacity.

Pressed Steel Car Company:
- 500 Hopper, 55 tons' capacity.

Ralston Steel Car Company:
- 550 Hopper, 55 tons' capacity.

Passenger Cars

American Car & Foundry Company:
- 40 Coaches for the N. Y. C.
- 15 Baggage for the M. C.
- 10 Baggage for the P. & L. E.

Pressed Steel Car Company:
- 4 Passenger and baggage for the N. Y. C.
- 35 Coaches for the N. Y. C.
- 15 Coaches for the P. & L. E.
- 2 Passenger and baggage for the M. C.
- 3 Passenger and baggage for the C. C. C. & St. L.

Pullman Car & Manufacturing Corporation:
- 20 Coaches for the C. C. C. & St. L.
- 2 Dining for the C. C. C. & St. L.
- 15 Coaches for the M. C.
- 3 Dining for the M. C.
- 15 Dining for the N. Y. C.

Standard Steel Car Company:
- 32 Baggage and mail for the N. Y. C.

Osgood Bradley Car Company:
- 25 Coaches for the N. Y. C.

Merchants Despatch Transportation Company:
- 20 Milk for the N. Y. C.

Company shops:
- 18 Baggage for the N. Y. C.

* These two Diesel engines are the first oil-electric road engines purchased by any railroad in the United States.

N. & W. improvements at Williamson, W. Va.

The Norfolk & Western is planning additions and improvements to its terminal facilities at Williamson, W. Va., as follows:

A 23-stall brick roundhouse, 130 ft. long.
A machine and smith shop of brick and steel, 95 ft. by 125 ft.
A two-story fireproof brick and concrete storehouse, 50 ft. by 100 ft.
An arch brick house of wood and corrugated iron, 36 ft. by 60 ft.
A wash and locker room of brick, 20 ft. by 70 ft.
A two-story brick office building, 50 ft. by 75 ft.
A fireproof brick and concrete oilhouse, 50 ft. by 75 ft.
A 100-ft. inspection pit of concrete.
Concrete extensions to the ash hoist.
A trainmen's lavatory, 28 ft. by 45 ft.
An electric repair shop of brick, 30 ft. by 40 ft.
Three ash hoists of concrete and steel.
Two concrete inspection pits 100 ft. long.
Two engine washing platforms, one a two-track platform.
An electric welding shop, 20 ft. by 30 ft.
An electric motor repair house, 110 ft. by 150 ft.
A pipe and tin shop, carpenter shop and stoker room, 25 ft. by 100 ft.
Track scales of 200 tons' capacity.
An icing station with a double platform 400 ft. long; a crusher house 48 ft. long; a platform 185 ft. long and an ice storage house 125 ft. long.

The estimated cost of this work is about $800,000.

In addition, 11 stalls are being added to the existing roundhouse to take care of repairs to heavier locomotives with 16,000 gal. tanks which have been used since the completion of the second track on the Big Sandy Line. This work involves an expenditure estimated at more than $69,000.

Meetings and Conventions

A. S. M. E. Railroad Division elects officers

THE AMERICAN SOCIETY FOR TESTING MATERIALS will hold its twenty-ninth annual meeting at the Chalfonte-Haddon Hall, Atlantic City, N. J., on June 21-25, 1926. The executive committee is considering the possibility of holding the 1927 annual meeting at some place other than at Atlantic City and has appointed a committee to canvass other locations and report its recommendations.

The following have been elected members of the Executive Committee of the Railroad Division of the American Society of Mechanical Engineers for 1926: Henry B. Oatley, vice-president, Superheater Company, New York (chairman); A. F. Stuebing, chief engineer, Bradford Corporation, New York; R. S. McConnell, Baldwin Locomotive Works, Philadelphia, Pa.; Wm. Elmer, superintendent Middle division, Pennsylvania, Altoona, Pa.; C. E. Chambers, superintendent of motive power and equipment, Central of New Jersey, Jersey City, N. J.; A. E. Ostrander, American Car & Foundry Company, New York; Eliot Sumner, superintendent of motive power, Pennsylvania, New York. Marion B. Richardson, associate editor, *Railway Mechanical Engineer*, New York, is secretary.

At the present time 413 members of the A. S. M. E. are enrolled in the Railroad Division. This number, however, does not include all of the members of the society who are interested in railroad work. In order to make the list as complete as possible, and also to extend the service of the Railroad Division to all members engaged in railroad work and allied industries, it is requested that those who have not already had their names enrolled as members of the Railroad Division do so at once.

Over 3,000 attend New York Railroad Club dinner

The New York Railroad Club held its annual dinner at the Hotel Commodore, New York, on December 17. The dinner celebrated the fifty-second anniversary of the club. Approximately 3,000 members and guests were in attendance.

W. F. Jones, general storekeeper of the New York Central, West Albany, N. Y., the president of the club, served as toastmaster. The principal speaker of the evening was Dr. Charles Alexander Richmond, president of Union College, Schenectady, N. Y. The subject of his address was "Fellowship"; it was a plea for better human relations, not only in industry but nationally and internationally as well.

An elaborate program of entertainment was provided, which included songs and humorous sketches by a group of entertainers and a serio-comic address by "Senator" Ford, the humorous speaker. A special feature of the program was the moving picture "close-ups" of "Our Presidents," which included not only prominent railway executives from Eastern territory, but leaders in the railroad supply industry and other prominent members of the club as well. Moving pictures were also shown of athletic events held by various railroads in recent months.

Decorations were elaborate and the railroad theme was carried in them throughout. Entrances to the ball-room of the hotel where the banquet was served were made to resemble station platform gates—half exact replicas of those in Grand Central Terminal, New York, and the other half similarly accurate reproductions of the gates, with train announcers and all, of the Pennsylvania station. Hotel employees were garbed as dining car waiters, red cap porters, gatemen and trainmen. On each table with the standard which bore the table number was a trainman's lantern, alight, with a red or green globe. Over the speaker's table was a New York Railroad Club banner with dates in the form of an electric sign, on either side of which a silken American flag in a spotlight's glare waved in an artificial breeze from an invisible source.

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations and railroad clubs.

AIR-BRAKE ASSOCIATION.—F. M. Nellis, Room 3014, 165 Broadway, New York City. Next convention May 4-6, New Orleans, La.

AMERICAN RAILROAD MASTER TINNERS', COPPERSMITHS' AND PIPEFITTERS' ASSOCIATION.—C. Borcherdt, 202 North Hamlin Ave., Chicago.

AMERICAN RAILWAY ASSOCIATION, DIVISION V.—MECHANICAL—V. R. Hawthorne, 431 South Dearborn St., Chicago. Next meeting June 9-16, inclusive, Young's Million Dollar Pier, Atlantic City, N. J.

DIVISION V.—EQUIPMENT PAINTING SECTION.—V. R. Hawthorne, Chicago. Next meeting September 21-23.

DIVISION VI.—PURCHASES AND STORES.—W. J. Farrell, 30 Vesey St., New York. Next meeting, June 9, 10 and 11, Atlantic City.

AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—G. G. Macina, 11402 Calumet Ave., Chicago. Annual convention September 1-3, Hotel Sherman, Chicago.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—Calvin W. Rice, 29 W. Thirty-ninth St., New York. Railroad Division, Marion B. Richardson, 30 Church St., New York.

AMERICAN SOCIETY FOR STEEL TREATING.—W. H. Eiseman, 4600 Prospect Ave., Cleveland, Ohio.

AMERICAN SOCIETY FOR TESTING MATERIALS.—C. L. Warwick, 1315 Spruce St., Philadelphia, Pa. Annual meeting June 21-25, Atlantic City.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS.—Joseph A. Andreucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago, Ill.

CANADIAN RAILWAY CLUB.—C. R. Crook, 129 Charron St., Montreal, Que. Regular meetings second Tuesday in each month, except June, July and August, at Windsor Hotel, Montreal, Que. Next meeting, January 12. Paper on Air Transportation will be read by Lt.-Col. Scott Williams, manager, traction department, Mussens, Ltd., Montreal. Moving pictures and slides.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—Aaron Kline, 626 N. Pine Ave., Chicago, Ill. Meeting second Monday in month, except June, July and August, Great Northern Hotel, Chicago, Ill.

CAR FOREMEN'S ASSOCIATION OF ST. LOUIS.—R. E. Giger, 721 North 23rd St., E. St. Louis, Ill. Meetings, first Tuesday in month, except June, July and August, at the American Hotel Annex, St. Louis.

CAR FOREMEN'S CLUB OF LOS ANGELES.—J. W. Krause, 514 East Eighth St., Los Angeles, Cal. Meeting second Friday of each month in the Pacific Electric Club Building, Los Angeles, Cal.

CENTRAL RAILWAY CLUB.—H. D. Vought, 26 Cortlandt St., New York, N. Y. Regular meetings, second Thursday each month, except June, July and August. Hotel Statler, Buffalo, N. Y. Next meeting January 14. Annual dinner in evening.

CHIEF INTERCHANGE CAR INSPECTORS' AND CAR FOREMEN'S ASSOCIATION.—A. S. Sternberg, Belt Railway, Clearing Station, Chicago.

CINCINNATI RAILWAY CLUB.—W. C. Cooder, Union Central Building, Cincinnati, Ohio. Meetings, second Tuesday, February, May, September and November. Next meeting February 9.

CLEVELAND STEAM RAILWAY CLUB.—F. L. Frericks, 14416 Adler Ave., Cleveland, Ohio. Meetings first Monday each month except July, August and September, at Hotel Cleveland, Public Square, Cleveland. Next meeting February 1. Discussion of 1926 A. R. A. Rules.

INTERNATIONAL RAILROAD MASTER BLACKSMITHS' ASSOCIATION.—W. J. Mayer, Michigan Central, 2347 Clark Ave., Detroit, Mich. Next convention August 17-19, Hotel Winton, Cleveland, Ohio.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—J. B. Hutchison, 1809 Capitol Ave., Omaha, Neb. Next meeting May 11-14, 1926, Hotel Sherman, Chicago.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—William Hall, 1061 W. Wabash Ave., Winona, Minn.

MASTER BOILERMAKERS' ASSOCIATION.—Harry D. Vought, 26 Cortlandt St., New York. Next meeting May 25-28, 1926, Hotel Statler, Buffalo, N. Y.

NEW ENGLAND RAILROAD CLUB.—W. E. Cade, Jr., 683 Atlantic Ave., Boston, Mass. Regular meeting second Tuesday in month, except June, July, August and September. Copley-Plaza Hotel, Boston, Mass.

NEW YORK RAILROAD CLUB.—H. D. Vought, 26 Cortlandt St., New York. Meeting third Friday in each month, except June, July and August, at 29 West Thirty-ninth St., New York.

NIAGARA FRONTIER CAR MEN'S ASSOCIATION.—George A. J. Hochgreb, 625 Brisbane Building, Buffalo, N. Y. Regular meetings, January, March, May, September and October.

PACIFIC RAILWAY CLUB.—W. S. Wollner, 64 Pine St., San Francisco, Cal. Regular meetings, second Thursday of each month in San Francisco and Oakland, Cal., alternately. Next meeting January 14. Motive power department night.

RAILWAY CLUB OF GREENVILLE.—F. D. Castor, clerk, maintenance of way department, Bessemer & Lake Erie, Greenville, Pa. Meeting last Friday of each month, except June, July and August.

RAILWAY CLUB OF PITTSBURGH.—J. D. Conway, 515 Grandview Ave., Pittsburgh, Pa. Regular meeting fourth Thursday in month, except June, July and August. Fort Pitt Hotel, Pittsburgh, Pa.

ST. LOUIS RAILWAY CLUB.—B. W. Frauenthal, Union Station, St. Louis, Mo. Regular meetings, second Friday in each month, except June, July and August. Next meeting December 11.

SOUTHEASTERN CARMEN'S INTERCHANGE ASSOCIATION.—J. E. Rubley, Southern Railway shops, Atlanta, Ga.

TRAVELING ENGINEERS' ASSOCIATION.—W. O. Thompson, 1177 East Ninety-eighth St., Cleveland, Ohio. Annual meeting September 14-17, Hotel Sherman, Chicago.

WESTERN RAILWAY CLUB.—Bruce V. Crandall, 226 W. Jackson Blvd., Chicago. Regular meetings, third Monday in each month, except June, July and August.

Supply Trade Notes

The Sherwin Williams Company will construct a three-story addition to its plant at Chicago.

Mudge & Co., Chicago, have been appointed western representatives for the Graham-White Sander Corporation, Roanoke, Va.

The Railway Motors Corporation, De Pere, Wis., has succeeded to the railway department of the Oneida Manufacturing Company, Green Bay, Wis.

James M. Buick, vice-president of the American Car & Foundry Company, at his own request has been relieved from the management of the sales department, a responsibility assumed six years ago. Mr. Buick, who has been connected with the company in an official capacity since its formation in 1899, will continue as vice-president, with headquarters in New York as heretofore. Herbert W. Wolff, who has been a vice-president since February, 1916, in charge of the Chicago district, has been appointed also manager of sales, succeeding Mr. Buick, and will be located in New York. Mr. Wolff was born on December 27, 1873, and was educated in the public schools of Detroit, Mich. He began his business career with the Michigan Car Company at Detroit in 1886 and when the Michigan and Peninsular car companies were merged in 1892 under the name of the Michigan Peninsular Car Company, he remained in the service of the consolidated corporation. Mr. Wolff was assistant mechanical engineer of this company in 1899 when the American Car & Foundry Company was formed and went to St. Louis, Mo., to become chief mechanical engineer of the new company. He was appointed assistant to the vice-president, with headquarters at St. Louis in 1912 and since 1916 has been vice-president in charge of the Chicago district.

H. W. Wolff

W. J. Henry has been appointed district manager of the Harnischfeger Corporation, Milwaukee, Wis., with headquarters at Charlotte, N. C.

H. A. Brinsley has been appointed service engineer of the Paige & Jones Chemical Company, railroad department, with headquarters at Ft. Wayne, Ind.

J A. Hamilton, representative of the Kerite Company, with headquarters at Chicago, has been transferred to New York, to succeed Percy Miller.

John E. Ferry, assistant to the president of the Franklin Railway Oil Company, Franklin, Pa., has been elected vice-president, with headquarters at Franklin.

Thomas O'Brien, for the past fifteen years engineer and sales manager for the John F. Allen Company, New York, has resigned to go into business for himself.

The General Electric Company has purchased 155 acres of land in St. Louis, Mo., at Birch street and Goodfellow avenue, upon which it plans to construct a plant.

The Interstate Car & Foundry Company, Indianapolis, Ind., has been incorporated to take over the business of the Interstate Car Company, of that city, under lease.

H. C. Haight, treasurer and general manager of the American Forge & Machine Company, Canton, Ohio, has been elected president, and will be succeeded by H. L. Barnes.

George L. Kippenberger, assistant to the vice-president of the St. Louis Car Company, St. Louis, Mo., has been promoted to vice-president and assistant general manager.

The Globe Steel Tubes Company, Chicago, has moved its Chicago office from the Peoples Gas building to Rooms 516 and 517 Wrigley building, 400 North Michigan avenue.

The Worthington Pump & Machinery Company, Cincinnati, Ohio, has awarded a contract to the H. K. Ferguson Company, Cleveland, Ohio, for a 115 by 140-ft. addition to its plant.

The Niles-Bement-Pond Company has sold its Pond works at Plainfield, N. J., and the tools, formerly built at Plainfield, will in future be built at the Niles Tool Works, Hamilton, Ohio.

The Independent Pneumatic Tool Company, Chicago, has opened a branch sales office and service station at 1103 Genesee building, Buffalo, N. Y., and has appointed Joseph P. Fletcher manager.

The name of Harry Vissering & Co., Chicago, has been changed to the Viloco Railway Equipment Company, Inc., following the sale of the entire interest held by Harry Vissering last February.

Ray A. Sossong, manager of gas plants, Air Reduction Sales Company, New York,, was elected president of the International Acetylene Association, at the recent annual convention in Chicago.

A. O. Norton, Inc., Boston, Mass., has opened an office at 2838 Grand Central Terminal, in charge of H. J. Wilson; and another at 421 Chestnut street, Philadelphia, in charge of O. L. Wright.

The Bonney Forge & Tool Works, Allentown, Pa., manufacturer of chrome vanadium drop-forged wrenches, has broken ground for an addition to its plant. The new building will be 110 ft. by 200 ft.

The Massachusetts Mohair Plush Company, Boston, Mass., has increased the territory of Midgley & Borrowdale, Chicago, to now cover the railroads in the whole western territory, west of Pittsburgh.

Frank W. Lampton has been appointed sales representative of the Hunt-Spiller Manufacturing Corporation, Boston, Mass., and will be located in the southwest territory. Mr. Lampton was born at Fort Scott, Kan., in 1890 and was educated in the public schools of that town, also in the Windsor Business College. He entered the employ of the St. Louis-San Francisco about 1907 as a machinist apprentice. After serving as a machinist on that road for about ten years, he became master mechanic of the Arcadia Coal & Mining Company. In August, 1920, he was appointed general foreman of the St. Louis & San Francisco at Wichita, Kan., later being transferred to Thayer, Mo. In November, 1922, he was appointed general foreman of the South Springfield Terminal, from which position he resigned to become a representative of the Hunt-Spiller Manufacturing Corporation.

Frank W. Lampton

The Morton Manufacturing Company, Chicago, has purchased the property adjacent to its present plant and is planning the construction of an addition which will provide 50,000 sq. ft. of additional shop space.

The Oneida Machinery Company, Oneida, Tenn., has awarded a contract for the construction of a new machine shop to the Austin Company, Cleveland, Ohio. The new unit will be a one-story, steel frame structure, 75 ft. by 142 ft.

The Yale & Towne Manufacturing Company, Stamford, Conn., has bought the Miller Lock Company, of Philadelphia, Pa., and it is to be operated in the future as the Miller Lock Works of the Yale & Towne Manufacturing Company.

George H. Criss has been appointed manager of the H. E. McCoy Company, Pittsburgh, Pa., who are sales representatives in western Pennsylvania and West Virginia, for The Baker-Raulang Company, Cleveland, Ohio, builder of industrial tractors and trucks.

Many additions are being made to the plant of the Ludlum Steel Company at Watervliet, N. Y. The capacity of the billet grinding department has been doubled and a modern exhaust system installed for the elimination of the dust incidental to all grinding operations.

J. N. Walker has been appointed general sales manager of the Oxweld Acetylene Company, New York; L. D. Burnett has been appointed eastern department sales manager, to succeed Mr. Walker, and Z T. Davis, Jr., is now assistant sales manager, eastern department.

Joseph C. McCune, engineer of the Eastern district of the Westinghouse Air Brake Company, has been appointed assistant director of engineering, with headquarters at Wilmerding, Pa. Mr. McCune was born in January, 1890, at Brilliant, Ohio. In 1906 he entered Washington and Jefferson College. He received the first Sibley prize for scholarship at Cornell and graduated from the university in 1911 with the degree of mechanical engineer. From July, 1911, to February, 1912, he was employed by the Cutler-Hammer Manufacturing Company, Milwaukee, Wis., and from the latter date until March, 1913, served with the Pittsburgh Railways Company. He then became assistant to the chief engineer of the Westinghouse Air Brake Company, and in May, 1915, mechanical expert, New York office, serving also on the Mexican border with the 7th Regiment, New York National Guard. From May, 1917, until August, 1919, he was 1st Lieutenant, Engineers of the United States Army, ten months of his service being in France. In September, 1919, he returned to the Westinghouse Air Brake Company as a special engineer at Wilmerding; in January, 1920, was promoted to assistant to district engineer; in October, 1920, became assistant district engineer, and in January, 1922, was appointed district engineer, with headquarters at New York. Mr. McCune is a junior member of the American Society of Mechanical Engineers, holding membership also in the Society of Automotive Engineers, the Air Brake Association, the Traveling Engineers' Association, etc.

Joseph C. McCune

The Baker R & L Company, Cleveland, Ohio, has changed its corporate name to The Baker-Raulang Company. The company manufactures electric industrial material handling tractors and trucks, under the Baker name, and also closed bodies for automobiles, under the name of Raulang.

The Standard Steel Car Company, Pittsburgh, Pa., has purchased the Siems-Stembel Company, St. Paul, Minn.; there will be no changes in personnel. P. C. Stembel, vice-president, will be in charge of the company's activities at St. Paul, and will represent the Standard Steel Car Company.

H. A. Watkins has been appointed metropolitan district sales manager for the Bridgeport Brass Company, with office in the Pershing Square building, New York City. Mr. Watkins was formerly superintendent of docks at New York City. He served as a major of engineers during the late war.

The Allis-Chalmers Manufacturing Company, Milwaukee, Wis., has opened a district office at Lima, Peru, in charge of W. G. Bolton. C. E. Phillips, representative of the company at Philadelphia, Pa., has been transferred to Wilkes-Barre, Pa. Mr. Phillips will be in charge of the Wilkes-Barre office.

T. D. Owler has been appointed Chicago railway sales representative of the Heywood-Wakefield Company, Wakefield, Mass. Mr. Owler has served for some time with Edward Buker, whom he succeeds as Chicago railway sales representative, Mr. Buker having resigned to go into business on his own account, effective January 1.

The Charles R. Long, Jr., Company, Louisville, Ky., has purchased a tract of land at Sixteenth and Hill streets, upon which it will construct a new plant and lacquer plant, to cost $450,000. The construction will be started immediately, the first unit to be four stories with basement, 70 ft. by 120 ft., and of reinforced concrete.

J. H. Ainsworth, railroad representative of the A. M. Byers Company, Pittsburgh, Pa., has been appointed director of railroad sales, with headquarters at Pittsburgh, and C. W. Damberg, formerly resident inspector of the New York, New Haven & Hartford, has been appointed railroad representative, with headquarters at New York.

The Russell-Burdsall-Ward Bolt & Nut Corporation, Rochester, N. Y., has awarded a contract for the design and construction of a wire mill at its Rock Falls, Ill., plant, to the Austin Company, Cleveland, Ohio. The new mill will be a one-story steel frame building, 85 by 160 ft., and will contain approximately 80 tons of structural steel.

W. J. Nugent, vice-president and general manager of the Nugent Steel Castings Company, Chicago, has been elected president of that company and Prentiss Coonley has been elected vice-president. Mr. Nugent entered the employ of the company in 1918 as vice-president, which position he held until 1921 when he became vice-president and general manager.

W. E. Hedgcock, assistant vice-president in charge of sales of the American Car & Foundry Company, at New York, has been elected a vice-president with duties as formerly. Oscar B. Cintas, vice-president of the American Car & Foundry Export Company, at New York, has been elected also as a vice-president of the American Car & Foundry Company.

Andrew Fletcher, president of the American Locomotive Company, died of heart disease on November 29 at his home in New York City. Mr. Fletcher came from a long line of shipbuilders of Scotch ancestry and was born in New York City on June 8, 1864. He was educated at the College of the City of New York, later studying naval architecture and marine engineering. Among the many important contributions that he made to American marine engine manufacture was his production of the first three turbine-driven vessels launched in the United States. The first was the Governor Cobb, followed by the Yale and the Harvard, fast boats operating between New York and Boston. It was Mr. Fletcher who changed the old side-wheel fashion for ferryboats, driving the boats with two propellers, one at each end. Later he added a further improvement, the double-compound Fletcher engine, which was stipulated as necessary by the New York Central when it placed a recent order for ferryboats.

Andrew Fletcher

Mr. Fletcher after serving as a director and a member of the executive committee of the American Locomotive Company for several years, was in December, 1916, elected as president, succeeding Waldo H. Marshall. He was also a director in the American Car & Foundry Company; American Locomotive Sales Corporation, of which he was president; Atlantic Gulf & West Indies Steamship Lines; Atlantic Gulf Corporation; Bucyrus Company; the Canadian Car & Foundry Company; Consolidated Iron Works, of which he was president; B. B. & R. Knight, Inc.; Lloyd's Register of Shipping for the United States; Montreal Locomotive Works, Ltd., of which he also was president; the Superheater Company; W. & W. Fletcher & Co. (North River

Iron Works); William Cramp & Sons Ship & Engine Building Company; Richmond Locomotive Works, of which he was also president; and the North River Derrick Company. He was a member of the executive committee of the Atlantic Gulf & West Indies Company and a trustee of the American Surety Company. He was also a member of the Society of Naval Architects and Marine Engineers, American Society of Mechanical Engineers, American Society of Naval Engineers and the Institution of Engineers and Shipbuilders, Scotland.

C. L. Wood, assistant general manager of sales of the Carnegie Steel Company, Pittsburgh, Pa., has been appointed general manager of sales, to succeed William G. Clyde, recently appointed president of the company. Samuel R. Hoover has been appointed assistant general manager of sales in charge of the bureau of bars and hoops, to succeed Mr. Wood.

William H. Woodin, president of the American Car & Foundry Company, has been elected also president of the American Locomotive Company, succeeding Andrew Fletcher, deceased. Mr. Woodin has been a director and member of the executive committee of the American Locomotive Company for many years. He is one of the largest individual stockholders of the company, in addition to which the American Car & Foundry Company has also large holdings in America Locomotive Company stock. Mr. Woodin was born at Berwick, Pa., May 27, 1868. He received a technical education at Columbia University, School of Mines, which he attended in the class of 1890. He served in the shops of the Jackson & Woodin Manufacturing Company at Berwick, and in 1892 was made general superintendent of that plant. In 1895 he was elected vice-president and in 1899 president. When the company was taken over by the American Car & Foundry Company in 1899 he was appointed district manager of the Berwick plant. He later became assistant to the first vice-president of the new company, then in 1902 he was made a director and assistant to the president, having general direction of the company's affairs under President Frederick H. Eaton, and on February 1, 1916, he succeeded to the presidency. As noted above, he has also been a director and member of the executive committee of the American Locomotive Company. He is chairman of the board of the Canadian Car & Foundry Company and a director of the American Exchange Securities Corporation, the American Beet Sugar Company, the Westinghouse Electric & Manufacturing Company, the Montreal Locomotive Works, the Westinghouse Electric International Company, the General Motors Corporation, the Cuba Company, the Cuba Railroad Company, the Compañia Cubana and the American Ship & Commerce Corporation.

W. H. Woodin

Clyde L. Jones has joined the sales force at St. Louis of the Reading Iron Company, Reading, Pa. Mr. Jones' headquarters are at 1819 Railway Exchange building, St. Louis, Mo. He has a wide experience in the pipe consuming field, having served in a similar position with the Interstate Pipe Company, from which company he resigned to go to the Reading Iron Company.

William V. Griffin, of the Anthony N. Brady estate, and Fred Allison, engineer of the Ford Motor Company, were elected directors at a recent meeting of the board of directors of the American Brown, Boveri Electric Corporation, New York. Laurence R. Wilder, president of the company, announced that it had taken over the Moloney Electrical Company, of St. Louis, Mo., manufacturer of transformers.

L. Wechsler now represents the Canton Foundry & Machine Company, Canton, Ohio, as general eastern sales manager of its New York City office at 203 East Fifteenth street, for the sale of its alligator shears, portable floor cranes and industrial turntables. Mr. Wechsler recently severed his connections as sales manager of the New York office of the Falls Hollow Staybolt Company, Cuyahoga Falls, Ohio.

The Oil Jack Company, Inc., New York, manufacturers of the Pedersen Oiljak, has appointed Fred D. Sweet manager of the middle western territory, with offices in the Wrigley building, Chicago, and the Charles M. Hoffman Company, Kansas City, Mo., as its representative in the southwestern district. The Oiljak is based on a new application of principles for lifting and is available in 10, 6, 3 and 1-ton capacities.

The American Brake Beam Manufacturers' Export Association, of West Nyack, N. Y., has filed papers under the export trade act (Webb-Pomerene law) with the Federal Trade Commission, for the purpose of exporting brake beams and parts pertaining thereto. The officers are R. H. Ripley, president; A. C. Moore, vice-president, and F. W. Edmunds, secretary-treasurer. Member companies are the American Steel Foundries and the Chicago Railway Equipment Company, both of Chicago.

H. E. Anderson, district manager of S. F. Bowser & Co., Inc., with headquarters at New York, has been promoted to manager of the northeastern division, with headquarters at Albany, N. Y., and will be succeeded by E. M. Harshbarger, manager of railroad sales, with headquarters at Fort Wayne, Ind. G. J. Komarek, chief sales correspondent in the lubrication and filtration division, with headquarters at Fort Wayne, Ind., has been promoted to district manager, with headquarters at Oklahoma City, Okla.

Henry D. Carlton, vice-president of Manning, Maxwell & Moore, Inc., New York, formerly in charge of the steam specialties department, has now assumed charge also of machine and crane sales. Joseph Wainwright, formerly eastern sales manager of the machinery department, has been appointed general sales manager of the machinery department with jurisdiction over all district offices. Thomas S. Stephens has been appointed manager of railroad sales of the machinery department and William D. Clarke has been appointed general sales manager of the crane department.

George P. Baldwin, general merchandising manager of the General Electric Company, Schenectady, N. Y., has been elected a vice-president. He will have charge of activities connected with the electrification of steam railroads and such other duties as may be assigned to him by the president. His new headquarters are at 120 Broadway, New York City. Charles E. Patterson, vice-president in charge of finance since 1920, is now vice-president in charge of all merchandising activities of the company, including the supervision of company supply houses. He will have his headquarters at Bridgeport, Conn. The accounting department responsibilities of Mr. Patterson have been assumed by the controller, S. L. Whitestone. Henry C. Houck, assistant general merchandise manager, has been appointed manager of the merchandise department of the Bridgeport works. George P. Baldwin was born in San Francisco, Cal., on January 22, 1874. He graduated from Leland Stanford University in 1896 with the A.B. degree. The following year he entered the employ of the Stanley Electric Manufacturing Company, which in 1903 was bought by the General Electric Company. At that time, Mr. Baldwin became vice-president of the Blaisdell Company of Los Angeles, where he remained until March 16, 1910, when he was made manager of the Pittsburgh office of the General Electric Company. On December 16, 1915, he was made manager of the Atlantic district, with headquarters at Philadelphia, Pa. When the merchandising department was created in 1923, he was made its first manager.

George P. Baldwin

Trade Publications

AIR COMPRESSORS.—Duplex single stage and two-stage cross-compound air compressors, Class DB and DE, are described and illustrated in a 16-page bulletin, Form No. 126, which has been issued by the Pennsylvania Pump & Compressor Company, Easton, Pa.

WELDING SUPPLIES.—The Lincoln Electric Company, Cleveland, Ohio, has issued a new catalogue dealing with welding supplies, including cables, glass, shields, welding electrodes, aprons, gloves, brushes, and other accessories needed for repair, structural or production jobs.

SPLICES AND TAPES.—"Splices and Tapes for Rubber Insulated Wires" is the title of a 16-page booklet issued by the Okonite Company, Passaic, N. J. The importance of a perfect splice; the important properties of tape; how to recognize these properties and how to make a perfect splice are the features described in this booklet.

SCREW MACHINES.—Specifications for plain, wire feed and automatic screw machines, attachments and tools are given in catalogue No. 24G issued by the Brown & Sharpe Manufacturing Company, Providence, R. I. The catalogue contains 140 illustrated pages and briefly outlines the development of the screw machine, also the manufacturing methods of the Brown & Sharpe Company.

ENGINEERING ACHIEVEMENTS.—Manuscript No. A-02458, descriptive of its engineering achievements for the year 1925, has been issued by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa. The developments cover equipment for the generation and distribution of power; steam turbines, condensers and stokers; heavy railway traction; radio, and miscellaneous achievements.

STEAM TURBINES.—Steam turbines rated at 500, 600 and 750 kw. are described in Bulletin GEA-235 issued by the General Electric Company, Schenectady, N. Y. The general principles and advantages of steam turbines are discussed, and section and steam path diagrams shown. The type D-54 turbine for the driving of centrifugal pumps, blowers and other classes of mechanical drive, is described in Bulletin GEA-197.

STEAM CONNECTIONS.—The Gold Car Heating & Lighting Company, Brooklyn, N. Y., has issued Bulletin No. 30 covering its 2-in. steam connections for the removal of the 1½-in. choke from between cars, giving a full 2-in. flow from the locomotive to rear end of train, including end valve, hose and fittings and steam hose coupler, which coupler, although of 2-in. size, will couple and lock with the 1½-in. couplers now in use, increasing the weight of the coupler but 14 oz.

MATERIALS HANDLING.—The Westinghouse Electric & Mfg. Company, East Pittsburgh, Pa., has issued Circular 7378 showing the results to be obtained in the various industries through the use of electrically-driven machinery for the handling of materials. Information and data covering the principal groups of materials handling machines and a description of the electrical devices developed by the Westinghouse Company for materials handling equipment, are contained in the circular.

INDUSTRIAL CONTROL CATALOGUE.—An industrial control catalogue of 160 pages has been issued by the General Electric Company, Schenectady, N. Y., furnishing information on its representative lines of industrial control and including a reprint of the industrial control section of its general catalogue; instructive matter on the care and operation of control devices; wiring diagrams of some standard controllers, push buttons and other accessories; reference tables; lists of publications, and other useful information.

"CONCENTRATION IN BOILERS."—This is the title of a 28-page bulletin, covering the methods and procedure in oil burner testing wherever the burners are fired under boilers or in warm air heating plants, which has just been issued by the American Oil Burner Association, New York. The bulletin discusses such theoretical considerations as are needed for the practical application of the methods and procedure given, which apply for both industrial and domestic burners. One of the principal purposes of preparing the bulletin was to provide under one cover all the important tables and formulas needed in testing burners, thus eliminating the usual annoyance and loss of time due to having to use a number of handbooks or references.

PATENTS.—The third edition of "Patents, Law and Practice" has been issued by Richards & Geier, patent and trade-mark attorneys, 277 Broadway, New York, and is available to manufacturers and those generally interested in the subject of inventions and their proper and adequate protection. Both United States and foreign patents are covered, information being given as to who may obtain patents, what may be patented, how to apply for a patent, the procedure followed in the patent office, interferences, reissues, appeals, infringements, etc. The charges for various services in connection with the preparation of the patent are given in schedule form.

GENERAL ELECTRIC PRODUCTS.—Catalogue 6001B, superseding all previous catalogues issued by the company, with the exception of those dealing with railway, mine and industrial supplies and merchandise products, is being distributed by the General Electric Company, Schenectady, N. Y. The book contains more than 1,100 pages and is thumb-indexed into sixteen sections as follows: Generation, wire and cable, distribution transformers, arresters, voltage regulators, switchboards and accessories, meters, instruments, motors, motor applications, industrial heating, miscellaneous and indexes. In the indexes products are classified both by subjects and by catalogue numbers.

BOILER TUBES.—The first half of Catalogue BT, issued by the Bethlehem Steel Company, Bethlehem, Pa., describes and illustrates the old-fashioned hand knobbling process for making pure charcoal iron for boiler tubes and gives a brief history of iron making and its connection with charcoal iron boiler tubes. The second half of the catalogue is devoted to the testing, inspection, weights and list prices of Bethlehem charcoal tubes, and covers the specifications for lap welded charcoal iron boiler tubes as issued by the American Society for Testing Materials, the American Society of Mechanical Engineers, and the American Railway Association, also the general rules and regulations prescribed by the Board of Supervising Inspectors.

SMALL TOOLS.—The Greenfield Tap & Die Corporation, Greenfield, Mass., has issued Small Tools catalogue No. 49, superseding catalogues Nos. 46A, 46A-2 and all others formerly issued under the names of Wells Brothers Company, Wiley & Russell Mfg. Company, F. E. Wells & Sons Company, A. J. Smart Mfg. Company and the Lincoln Twist Drill Company. Taps and dies, screw plates, twist drills, reamers, screw slotting cutters, gages, pipe tools and bolt threading machines are listed in this catalogue, a thumb index providing easy reference to the individual tools. The gages and bolt and pipe threading machines are listed for the first time in this catalogue of 384 pages. The special method of packing screw plates for domestic trade is also described.

"COMPARISON OF DIESEL ENGINE PRINCIPLES."—This is the title of Bulletin No. 1020 recently issued by Fairbanks, Morse & Co., Chicago. The bulletin is a clear, non-technical exposition of the various principles of operation on which Diesel engines have been developed, in which is set forth the reasons why this company has adopted the two-stroke cycle, airless fuel injection principle in its stationary and marine Diesel engines. In addition to the discussion of the advantages of the two-cycle principle and the airless fuel injection, the bulletin explains the two-stage process of combustion incorporated in Fairbanks-Morse engines, the fuel economy, factors affecting heat dissipation and the speed control and regulation of these engines. The bulletin is thoroughly illustrated with both photographs and diagrams.

INSTRUCTION BOOK ON INTERNAL GRINDING.—The Micro Machine Company, Bettendorf, Ia., has recently issued a simple, concise manual of instructions covering the operation and care of the Micro internal grinder, together with general information on the art of internal grinding. This book is written to assist purchasers of the Micro internal grinder in obtaining the best results from their machines. The book is carefully prepared and comprehensive in character, being divided in general into three sections on grinding wheels, general operating instructions, and locomotive air compressor grinding. Important tables are included to assist in the selection of the proper grinding wheels for cast iron, hardened steel and soft steel grinding. Complete instructions are also included regarding correct speeds and the arrangement of the machine for wet grinding. An important page of "Micro Don'ts" is included in the back part of the book.

Personal Mention

General

F. P. Pfahler has been appointed assistant to the chief of motive power and equipment of the Seaboard Air Line, with headquarters at Savannah, Ga., a newly created position.

Master Mechanics and Road Foremen

J. H. Weber has been promoted to assistant road foreman of engines, of the Seaboard Air Line, with headquarters at Tampa, Fla.

R. L. Kirkland has been promoted to assistant road foreman of engines of the Seaboard Air Line, with headquarters at Tampa, Fla.

E. R. Dowdy has been appointed assistant master mechanic of the Chesapeake & Ohio, with headquarters at the Fulton shops, Richmond, Va.

H. Y. Harris has been appointed master mechanic of the Seaboard Air Line, the Tampa & Gulf Coast and the Tampa Northern, with headquarters at Tampa, Fla.

Harvey J. McCracken, whose appointment as master mechanic of the Stockton division of the Southern Pacific, at Tracy, Cal., was announced in the December issue of the *Railway Mechanical Engineer*, was born on October 24, 1873, at Thornton, Cook Co., Ill. He attended the public schools of Thornton and Auburn Park, Ill., entering the service of the Belt Railway of Chicago on October 19, 1891, and serving four years apprenticeship and five years as boilermaker with that company. In November, 1900, he entered the service of the Southern Pacific as a boilermaker at Sacramento, Cal., and in January, 1904, was transferred to Portland, Ore., as foreman boilermaker of the Portland division. In March, 1912, he was appointed district boiler inspector of the Northern District, with headquarters at Portland. In February, 1914, the Northern and Central districts of the Southern Pacific were consolidated, and Mr. McCracken continued as district inspector of the consolidated territory, comprising six northern divisions. In April, 1925, he was appointed assistant master mechanic of the Western division, with headquarters at West Oakland, Cal., where he remained until his appointment as master mechanic of the Stockton division.

H. J. McCracken

H. M. Agin has been appointed road foreman of engines of the Seaboard Air Line, the Tampa & Gulf Coast and the Tampa Northern with headquarters at Waldo, Fla.

R. R. Harris has been appointed road foreman of engines of the Seaboard Air Line, the Tampa & Gulf Coast and the Tampa Northern, with headquarters at Tampa, Fla.

C. E. Plott, road foreman of engines of the Chicago, Burlington & Quincy, at Centralia, Ill., has been promoted to general roundhouse foreman, with headquarters at Burlington, Iowa.

W. L. Longstreth, assistant road foreman of engines of the Panhandle division of the Pennsylvania, with headquarters at Columbus, O., has been transferred to the Eastern division, with headquarters at Pittsburgh, Pa.

A. B. Ford, general master mechanic of the Central district of the Great Northern, with headquarters at Great Falls, Mont., has been transferred to the Lake and Eastern districts, with headquarters at Duluth, Minn., succeeding T. E. Cannon, who has retired.

Shop and Enginehouse

Michael Branch has been appointed tool supervisor of the Chesapeake & Ohio, with headquarters at Huntington, W. Va.

A. B. Chapman has been appointed supervisor of welding of the Chesapeake & Ohio, with headquarters at Huntington, W. Va.

R. G. Fields has been promoted to assistant night roundhouse foreman of the Finley shops of the Southern, with headquarters at Birmingham, Ala.

C. T. Bryant, gang foreman of the Huntington shops of the Chesapeake & Ohio, has been promoted to general foreman, with headquarters at Peru, Ind.

F. B. Downey, general foreman of the Chesapeake & Ohio at Covington, Ky., has been promoted to general foreman of the Huntington, W. Va., shops.

James M. Plaskitt, mechanical engineer, Finley shops, Southern, Birmingham, Ala., has been appointed night enginehouse foreman, with headquarters at Finley.

F. L. Brower has been promoted to assistant roundhouse foreman of the Finley shops of the Southern, with headquarters at Birmingham, Ala., succeeding R. G. Fields.

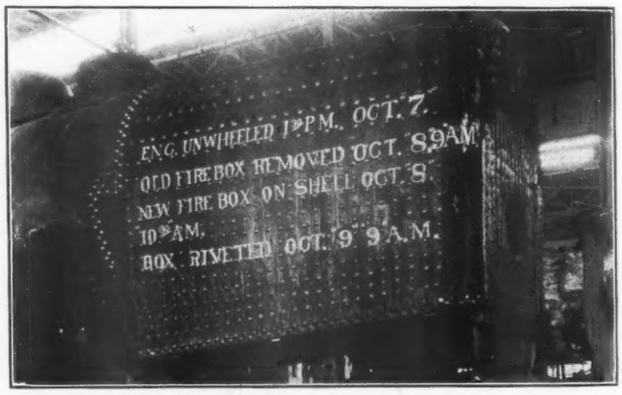
W. R. Reiman, night roundhouse foreman of the Chicago & Northwestern at Chicago, has been promoted to general roundhouse foreman, with headquarters at Clinton, Iowa.

Harry F. Martyr, roundhouse foreman of the Kansas City Terminal, has been appointed general foreman, with headquarters at Kansas City, Mo. Mr. Martyr began his railroad career on the London & Northwestern, England, in 1890, coming to America in September, 1897, and entering the service of the Missouri Pacific at St. Louis. Later he was employed by the Lima Locomotive Works and the Standard Oil Company. Returning to railroad work, he served successively as a machinist, machine shop foreman, roundhouse foreman and general foreman of the Frisco System. In 1907, he became general foreman of the Detroit, Toledo & Ironton at Jackson, Ohio, and in 1911, entered the service of the Rock Island, his last position on that road being general foreman of the locomotive shops at Horton, Kan. In September, 1919, Mr. Martyr was appointed master mechanic of the St. Louis & Hannibal at Hannibal, Mo., and was later employed by the Crandall Packing Company. In February, 1923, he became roundhouse foreman of the Kansas City Terminal. Mr. Martyr is a charter member of the Railway General Foremen's Association, of which organization he has served as treasurer.

Purchasing and Stores

F. C. Newman has been appointed storekeeper of the Southern, with headquarters at Hayne, S. C.

J. H. Smith, storekeeper of the Southern at Hayne, S. C., has been appointed division storekeeper, with headquarters at Atlanta, Ga., succeeding G. A. Blackwell, deceased.



New firebox is installed in record time at the Burnham shops of the D. & R. G. W.